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Visionary Leadership Phenomenon in School Management

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Abstract

The aim of this study is to examine the concept of vision and visionary leadership, of which importance is being understood more and more in the management of educational institutions, and to reveal the positive differences between school administrators with visionary leadership characteristics. In the study, which was designed as a review article, the concepts of leader, manager, vision, and visionary leader were considered in the literature, and the features of visionary leadership, which are open to change and innovation, constantly improving themselves, inspiring the people they work with, guiding them, walking the path together and helping them when necessary, realizing the goals determined have been revealed. Therefore, it has been revealed that visionary school administrators are more peaceful and happier with the internal and external stakeholders they work with in their institutions, they move more confidently to the place where they are thought to be in the future determined for the institution, and that their institution is more preferable than the equivalent institutions around it. Besides, it has been indicated that the school includes innovative educational practices and student-centered studies, supports pluralistic participation in all areas, and shares its authority by giving responsibility. In this regard, the necessity of making legal arrangements that will reveal visionary leaders is an inevitable requirement for the future of the country and the accomplishment of the institutions.

Keywords: Vision, Visionary leadership, School management.

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Introduction

As a social being, human needs to be in a group by nature and feels obliged to act in groups. For this reason, he interacts with the group with his actions and tries to recognize the goals and objectives of that group. In fact, the creation and mobilization of groups of people oriented toward certain goals and targets require a separate skill and persuasion ability. For this reason, there is a need for people who are needed, who can activate the group dynamics and who can achieve the desired goals. The emergence of these people enabled people to come face to face with different phenomena and concepts and revealed the concept of leadership.

Fundamentally, the concept of leadership, which consists of influencing the group and reaching the goal by persuading them (Acar, 2006), is to create a vision and encourage a culture that supports and can achieve this vision (Yielder & Codling, 2004). Visionary leadership, on the other hand, is not limited to the concept of leadership, but requires looking to the future with a new perspective. In addition, the visionary leader has the ability to influence and mobilize people collectively, inspire group stakeholders, and create a synthesis by blending the future with the past.

One of the reasons for the gap in terms of success between schools stems from the understanding of leadership and management in institutions. With the global change, the world has become a small village and the events that have taken place have affected everyone individually. School administrators, who could not catch up with the era, could not follow the changes in the current world and left their institutions behind these innovations. In the process of rapid change occurring in the world, visionary administrators and leaders who carry the school forward can make the institution preferable by showing themselves in the quality of the school and the success of the students.

Management and Leadership

Management and leadership concepts; despite being seen as similar in terms of directing and managing individuals, it is likely to say that there are fundamental differences between these two concepts. A leader is a person who can gather a group around certain goals and has the ability and knowledge to influence and mobilize them for these purposes. As can be understood from this explanation, the core of leadership consists of influencing others and directing them to behave. In short, the leader is a guide who can influence others, show where and how to go, and set goals and tasks, that is guide.

Management, on the other hand, reflects the organizational hierarchy and the manager is appointed from above for a task (Yielder & Codling, 2004). An executive is defined as a person who provides management on behalf of others, makes efforts to achieve predetermined goals, carries out work in a planned way, and tries to control (Oğuz, 2015). In this regard, it is used to express management, authority, and status (Topçu, 2017).

As mentioned above, management and leadership have different meanings, and managers and leaders also express different characteristics, roles, and behaviors. However, sometimes one can be used interchangeably in everyday language. It should be noted that, unlike management, the emotional side of leadership outweighs the intellectual

and cognitive side. On the other hand, these concepts are not synonymous. Some people can be both a good manager and a good leader, some people become managers and cannot be leaders, and some people become leaders and cannot be managers. A manager can be defined as a person who tries to achieve organizational goals by using all available resources and organizational and managerial processes. Ideally, however, managers are expected to be leaders as well. However, it can be said that this is not the case for most managers (Şişman, 1997).

Some scientists who have researched on the phenomenon of leadership have tried to describe the differences between them by comparing the concepts of leadership and management. According to Bush (2008), leadership is independent of authority while the administration is directly subordinate to institutional authority. As the manager is appointed by his superiors, the leader tries to reach the result by using the ways of sanctions and rewards thanks to his authority and position; he is someone who influences people and shows people what can be done and how can it be done. If a manager is able to exceed certain practices and certain sources of authority in influencing and directing the thoughts, moods, values, beliefs and behaviors of his employees, he or she has leadership characteristics (Tahaoğlu & Gedikoğlu, 2009). In this respect, it is possible to talk about situations where manager and leader characteristics converge and merge. The main differences between leadership and management are given below.

Table 1. Fundamental Differences Between Leader and Manager

Manager	**Leader**
managing	innovative
repetitive	original
Concervative	Making improvements
Focuses on the system and structure	Focuses on people
Relies on supervision	Honest, relies on facts
Has a short term perspective	Has a long term perspective
Asks how and when questions	"why" questions
Accepts the current conditions	**Opposes the current conditions**
Depends on Orders	Being himself
Thoughts are right	Thinks in the right way

(Source: Bennis, 1989 as cited in Keçecioğlu, 1998)

While (Babil, 2009) states that the leader should be an honest and respected person in order to influence those who follow him, (Ürkmez, 2008) states that the leader should be the person who sees what everyone cannot see. While (Çelik, 2009) states that the leader should be able to communicate and cooperate well with the followers (Aydın, 1998), a manager with leadership characteristics states that he/she should have the ability to influence those around him and to create a conscious community in order to achieve goals beyond what they hoped for. According to (Bridge, 2003), the leader should have the potential to overcome obstacles and failures with his guiding and forward-looking view, knowing what he wants to do, while according to (Çelik, 2000), he should be

able to use the power of the followers well and use them appropriately. According to (Doğan, 2007), leaders should be well educated and able to influence those at the lower level with their expertise.

Stogdill stated five basic characteristics of leaders that differ from followers (Lunenburg, Ornstein, 1991).

1. Capacity (Intelligence, attentiveness, originality, and judgment)
2. Achievement (Education, knowledge, and athletic achievement)
3. Responsibility (Dependence initiative, resistance aggression, self-confidence and desire to excel)
4. Participation (Activity, sociability, cooperation, adaptability, and wit)
5. Position (Socioeconomic position and popularity)

A leader is someone who integrates, inspires and exhilarates, invigorates, innovates and leaves a lasting impression. The main characteristics of the leader that reveal his personality and cannot be acquired later are four. These, together with the innate characteristics, form the personality that develops in the first twenty years of his life. These features are; honesty, foresight, stability and professional competence. (Baltaş & Baltaş, 2004). In short, the leader assumes a creative and initiating role in the realization and development of certain goals of the organization. Since the leader has the authority to take all kinds of critical decisions about the organization, the leader must be forward-thinking, visionary, and able to set goals and direct people in this regard in order to make decisions for the benefit of the organization (Şişman & Turan, 2002).

Leadership Approaches

From the leadership research that started in the 1900s to the present, many different views on leadership have been expressed, but the generally accepted conceptual leadership theories are discussed under three titles as trait theory, behavioral theory and contingency theory (Çelik, 2000). The model in which the development of leadership approaches is explained in the historical process is as follows.

Traditional Leadership Approaches

Features Approach

The first emerging approach to leadership is the traits approach. In this approach, it comes to the fore that the qualities of the leader are the most important factors in determining active leadership. In other words, the unique characteristics of the leader enable him to lead and manage the group within the organization. A leader is a person who differs from group members because of his personal characteristics. According to this approach, it is important for a person to have different characteristics in order to be a leader (Koçel, 2001). According to the trait theory, one cannot become a leader later on, leadership is an innate trait. A person is distinguished from others by virtue of his characteristics. Physical characteristics (height, age, weight), personal characteristics (intelligence, education, communication power, confidence), emotional characteristics (perception, high sense of achievement, sense of trust), social characteristics (success, good communication, certain features such as self-acceptance) were emphasized (Koçel, 2001).

Behavioral Approaches

In behavioral theory, what the leader does is defined. Accordingly, leadership behaviors are determined, and the view that a person can have these behaviors in terms of the way in which education is emphasized. Thus, the thesis of the traits approach has been tried to be disproved. The main idea of the behaviorist leader theory is that the behaviors exhibited by the leader in the leadership process make him an effective and successful leader rather than the qualities of the leader (Peker, 2003). The leader's personal qualities are replaced by his behavior towards everyone. In behavioral theory, researchers mainly focused on two leadership styles. The success and effectiveness of the leader does not depend on his characteristics, but on the behaviors displayed by the leader during his leadership, which determines the behaviors such as the way the leader communicates with his followers and sets goals (Tengillimioğlu, 2005). The main difference between trait theory and behavioral theory is that behaviors can be learned.

Contingency Approach

After the 1960s, leadership approaches were also influenced by the radical changes in the field of management and focused on the environment in which the leader and the group interact. Contingency approaches suggest that different events and circumstances require changes in leadership style. Accordingly, the leadership style may change according to the current situation, sometimes a democratic attitude stands out, and sometimes an authoritarian attitude can have the effect (Mohan, 2001).

The contingency approach generally rejects effective leadership and management style, unlike other approaches. Contingency approach; He argues that the aim and quality of leadership vary according to the characteristics of the group members, the characteristics of the organization, experiences and personality traits. In the contingency theory, it has been stated that different situations require different leadership, and the issue of what the leadership style can be according to these situations has been given importance (Zel, 2001). It has been stated that the most appropriate leadership behavior may change according to the situation and that there is no single and best leadership style.

Modern Leadership Theories

Modern leadership approaches have revealed the different aspects of the leadership process that were ignored before, and the size of the relationship between the leader and his followers constituted the main elements of the studies as the most important difference.

Charismatic Leadership

Personal characteristics of the leader come to the fore in charismatic leadership. Trust, respect and sincere commitment are among the characteristics of charismatic leadership. These leaders have left emotionally intense images on their followers by establishing a very strong identification with their personalities. The effect of

emotions such as enthusiasm, confidence, commitment to personal goals, and fear on employees has been enhanced. According to some traditional thinkers, it is perceived that charisma forms the basis of the leading power of leaders. However, the findings obtained in studies have revealed that charisma is a general feature and that the same characteristics can be found in the leader's subordinates (Dubinsky et al., 1995).
Charismatic leaders put themselves at risk, make sacrifices, and gain the trust of their followers. The charismatic leader has full self-confidence. Charismatic leaders demonstrate their uniqueness by finding original ways of finding organizational goals. They make very good use of the environmental factor and the opportunities that arise. They show the sensitivity they show in many issues to their followers. They have the courage to implement rational changes by imagining different dimensions from the situation they are in.

Transformational Leadership

Increasing competition in the globalizing world has forced businesses to restructure all their resources and production processes. Thus, the direction of change has changed. In today's changing and increasingly competitive environment, the need for transformational or transformational leaders who give strategic goals, explain vision and enable them to participate in decisions that motivate their subordinates is increasing. Such leaders develop new forward-looking methods, introduce new strategic conditions, and keep up with the pace of innovation. The most important feature of change leaders is that they are open to continuous learning (Eren, 2004).

They chase after their big goals and ideals, and this requires constant learning. Transformational leadership places emphasis on common virtues such as freedom, equality, justice, and fraternity. In this leadership, the bonds between the team and the environment and the core goals of the organization are valued. This style of leadership aims to improve the uniform and pragmatic efforts of employees who are oriented toward big goals. The energy, which is formed by the influence of the people in the organization depending on the shared goals, enables the group and individual goals to be realized more easily. In transformational leadership, people's attitudes, thoughts, and values for a certain purpose; it turns into attitudes, thoughts and values that consider others (Starratt, 1995).

Transformational leaders encourage the continuous development, improvement and growth of their subordinates, guide them, increase their personal competence with development and training policies, and develop methods to increase the success of their subordinates. Apart from this, it is also necessary for the transformative leader to be able to define ways and make plans in order to achieve the goal. Transformational leadership consists of inspirational leadership, individual attention, ideal influence and charisma and mental stimulation sub-dimensions.

Interactive Leadership

Because a leader believes that results will create meanings, he adjusts the whole adaptation process according to results. When this type of leader is in question, it is based on preferring what is beneficial for the guidance of the employees, and there is an understanding that considers the employees as a tool within the organization and sees reward and punishment practices as an effective method. In the interactional leadership style, there is a change-

oriented relationship between the leader and the followers. In other words, some rewards are received in return for the attitude of the followers of the leader (Berber, 2000). Leadership gives subordinates the role of interacting, understanding, and influencing the leader in the organization, and transactional leaders motivate their employees to do what is asked of them. The power of subordinates depends on the power of the leader.

Transactional leaders present the needs of their subordinates and provide the necessary support in order to achieve the goals of the organization. Leaders use punishment to motivate subordinates. The fact that the leader has a high commitment to the current situation and the tendency to strengthen this culture by preserving the existing orders and business culture shows that he has a leadership understanding that implements traditional management strategies (Zel, 2001).

Strategic Leadership

Strategy is expressed as directing to a certain purpose, providing joint action and regulation. Strategic leadership is explained as developing a foresight about what may happen in the future and designing plans that will adapt without losing time in the face of possible changes. In management science, it is explained as the ways that the organization follows in order to achieve the goal it wants to achieve. The strategic leader includes every unit of the organization in the strategy process that develops as a result of correctly analyzing the internal and external environmental conditions in the place where the organization is located and acting with the right strategy at the right time. Strategic leadership, in today's world where change is experienced very rapidly, makes its importance felt with the mobility in competitive environments. In addition, strategic leadership is important in order to respond more quickly to the risks and dangers developed by the effect of globalization (Kirim, 2002). In this leadership, there is the ability to create and dominate change, to perceive risks differently and turn them into opportunities, to start working for goals from today, and to have the intuition, common sense, and vision necessary for change.

Quantum Leadership

This type of leadership has been created based on quantum physics. In quantum physics, when the assumption that objects have wave and particle properties together is put forward and evaluated, leadership is resolved as an interaction field expressing the same integrity in the follower and leader dilemma (Erçetin, 2000). This type of leadership, unlike the traditional understanding, does not consider the followers and the leader separately. Quantum leadership explains that the leader can be strong when the followers are evaluated holistically. Therefore, both a follower and a leader are needed in order to create the energy that drives the organization. While the leader directs the people around him, the followers help him/her move forward with the support they give him (Blank, 1999).

In the quantum leadership approach, leadership can always change hands. The leader gains the support he receives from his followers not from the power of the status quo, but from trust, commitment and mutual respect. On the

basis of this approach, it is impossible to keep up with the speed of change and in case of confusion in parallel with this change, the quantum leader approach clarifies the management of uncertainty (Erçetin, 2000).

Super Leadership

Introduced by Charlez Manz and Henry Sims, super leadership also expressed as self-leadership reveals the leader's self-leadership energy that exists in every person. Rather than the leader determining a direction for his followers and making them move in that direction, it is about maximizing the efforts of the followers by giving them the responsibility of their own actions (Doğan, 2001). The fundamental idea of this leadership style is to give responsibility to followers who can become self-leaders. The task of the leader is to contribute more to the followers by helping them to develop their skills and become their own leaders. The principles of super-leadership are to create self-directed workgroups, to enable employees to think positively, to set goals for themselves, and to enable them to learn (Aktan, 1997).

The Concept of Vision

The concept of vision, which is a concrete vision of the future, is so close that we can see its realization, but so far away that we cannot claim that it will not be a new reality, and it is admirably distant. Vision is the creation in the thought of a situation that can happen or be created in the future. This image can be created by processing information about the future with rational methods, as well as by subjective perceptions of developments pointing to the future (Ali Akdemir, 1998).

The vision enables leaders to go beyond everyday issues and create a framework within which they can work for the future. A leader, his vision and values; uses it to mobilize people, facilitate change and growth, and create a future for the organization. The leader's vision is the template for the organization. It is a picture of the possible, of a better future. The vision should clarify the main direction, instill a sense of shared purpose, and make clear what the organization will strive to become. According to Özden (1998), vision is a concrete vision of the future that reconstructs reality, creates its own future, dreams in accordance with the goals to be achieved in the future, experiences a creative tension and sees the current situation as a problem.

Visionary Leadership

While defining the concept of leadership, the explanation reflects the characteristics of the period in which it was made. When a definition is made considering today's conditions, meanings such as being compatible with the characteristics of the information age, favoring change, prioritizing communication, and giving priority to information are loaded. Recently, organizations choose leadership that can make strategic plans according to radical changes, recognize opportunities, involve employees in the process, develop creativity, cares about human resources management, and combines a leader and vision, rather than surviving today. The explanations put forward in this direction show that the visionary leader type is one of the leadership models that organizations want to work with.

Visionary leadership is to create a balance between the reality of the time and the reality that will be encountered in the future (Erçetin, 2000). A visionary leader is someone who, apart from creating a vision, has the ability to convey this vision to his followers. The visionary leader should determine the way to go, take the right decisions at the right time and convey this to his followers, and prepare and implement a change plan suitable for different conditions. The visionary leader is not content with verbal expressions about the vision, but also reflects the vision feature in his behaviors (Robbins, 2000).

A visionary leader who encourages people, directs them toward common goals, and paints the future, is one who can do effective work with his vision by establishing the link between a clear understanding of the time he is in and motivation, by making a joint effort (Yılmaz & Akdemir, 2005). Visionary leaders motivate employees with vision. The leader, who is the head of the organizational vision, enables the employees to concentrate on the future organizational goals. Visionary leaders, while focusing on the purpose of their employees, take into account their opinions, are in contact, and are respectful to the values they believe in. By distributing the authority over the visionary leaders to their subordinates, they also take their thoughts into consideration in the plan and program, by sharing the responsibilities. Thus, by spreading the vision to the whole organization, they ensure that the employees adopt the vision and be successful at an advanced level (Quigley, 1998).

School administrators, being visionary leaders, are people who can open new horizons in schools. With these horizons they expand, they make their schools more effective. In other words, the effectiveness of schools depends on the presence of visionary leaders (Acar, 2006). School administrators; Together with the teachers, they should create a vision that will lead the institution to success, develop strong strategies on the way to the vision, and move quickly on the path to success with a proactive approach that turns threats into opportunities (Tekin & Ehtiyar, 2011).

Rapid changes in the education system, teaching methods, and educational technologies require the school administrator to make strategic decisions as a visionary leader (Öztürk, 2008). The visionary leader should follow the changes made in the field of education while creating a forward-looking vision (Çelik, 1997). As can be understood from these statements, a leader with a visionary feature should always be ahead of time. Visionary leaders are always open to communication. They inspire and always guide those who follow them. It is seen that a visionary leader gives importance to employee performances. This situation affects the employees and their performance increases. The visionary leadership approach, which gives importance to being in harmony with its team, is important for today's educational institutions (Gül, 2019).

Çelik (1997), who revealed the roles of visionary leadership, examined these roles under three main headings. Accordingly, visionary leadership roles are conceptualized as seeing the way, walking on the way, and being the way. In terms of visionary leadership, to see the way is to see the future image of the vision and the place to be reached. The visionary leader should be able to look from different angles and see the right path. There should be a concern to see the plan and the way forward. Because the visionary leader is the person who opens the horizon of the future in this direction by carrying an emotional and intellectual pain for the future. The visionary leader

sees the future with an intuitive power, opens the curtain of the future and draws the map of the future. We can see this map drawn as a vision. In terms of visionary leadership, walking this path is as important as seeing the path to success. Walking on the drawn path requires determination. In this sense, the visible path and the path traveled must be the same. There have been such leaders who set goals for themselves that despite trying to walk towards the goal they set, they stray from the path and cannot reach this goal. The new role that the visionary leader will take as a result of the goals achieved by successfully progressing on the path drawn in terms of visionary leadership is to be the path. To be the way is to make way for the followers. The followers try to walk on this path opened by the visionary leader. The vision is completed with the success achieved as a result of following the path found with thought and intuition. In this way, the path opened by the visionary leader becomes a safe place for those who follow it as a vision. Accordingly, visionary leaders should see the way of the organization, walk that way with the organization and its employees, and be the way of the organization.

School Management and Visionary Leadership

The school principal, who plays a key role in creating a vision for the school and putting it into practice, has to set an example for the teachers, assistant principals and personnel working in his administration with his visionary feature. A visionary manager should include the views of teachers while creating a vision, and should do his best to include them in this process. In order to realize the vision, conditions should be created to provide support for teachers (Şişman, 2002).

The school principal, who has to be a good model for the employees of the institution under the roof of the school, in terms of individual and professional qualities, should follow the researches and innovations in the literature on education and learning and share them with his staff (Şişman, 2002). The school administrator, who has visionary leadership characteristics, is a leader whose vision is adopted by each individual in the school through his foresight and thoughts. In summary, school administrators should go beyond managing the school only according to written rules, perceive schools as a functional center of human dynamics, and strive to increase people's sense of dedication to the institution they work with, with forward-looking plans (Kalyoncu, 2008).

The quality of education in schools is closely related to the visionary leadership behaviors of their managers. The vision feature enables leaders to be forward-thinking. Creating a vision is a very important leadership task that cannot be postponed or left to the next generations. The vision is created and executed by the person at the top of the organization (Özden, 2005). At the same time, it is inevitable for the school, which is in constant interaction with the people around it, to change. In such a case, success in change is related to the prerequisite for determining the vision and mission (Çalık 2003).

Conclusions

A constructive and visionary leader who takes the institution forward; should value good ideas wherever they come from, find solutions with stakeholder participation rather than reacting to problems, avoid short-term universal solutions, be honest and reliable, and give importance to teamwork. Visionary leaders, who drag people

behind them with their vision and open new paths with the visions they produce, give the organization a sense of direction, draw the future picture of the organization and carry their followers to the desired goals.

Visionary leadership, which is concerned with shared values within a very broad framework such as freedom, equality, justice and fraternity; aims to adapt to the rapidly changing environment based on the aim of realizing organizational transformation and progress. As the famous philosopher Heraclitus stated, *"The only thing that does not change is change itself."* Based on the principle of change in organizations is inevitable. Only a visionary leader can transform this change into development.

Encouraging visionary leaders who support development and creating a perfect workspace for them should be among the main duties of the Ministry of National Education. At this point, the legislator should make school management a primary duty rather than a secondary duty. As the Ministry, studies should be organized to reveal the hidden visionary aspects of school administrators, and administrators should be encouraged in this regard. At the point of reaching the goals we desire as a country, the future goals of our school administrators and the success of the students we want to achieve will be realized in schools with visionary leaders.

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The Effect of Using the 5E Instructional Model on Students' Performance in and Motivation to Learn Sine Rule and its Applications

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Abstract

This study investigated the effect of using the 5E instructional model on Senior High School student's mathematical achievement in the application of the sine rule. A quasi-experimental, non-equivalent control group, pre- post-test research design was used in the study. Convenience sampling technique was used to select two intact class groups' representing a control and an experimental group. Trigonometry tests (pre-test & post-test) and questionnaires which generated quantitative and qualitative data were used to collect data. Descriptive, inferential and thematic analytical methods were used to analyze the data generated. The results showed that there was a significant difference between the mean performances of the experimental and control group. The average mean performances of each of the two groups showed that the experimental group performed better than the control group. Again, the results showed that the use of the 5E instructional model was fun, practical, interactive and interesting hence motivates students to learn trigonometry, specifically sine rule and it's application. The study recommended that Mathematics teachers should adapt the 5E instructional model in teaching trigonometric concepts to promote retention and transfer of knowledge.

Keywords: 5E Learning model, Motivation, Sine rule, Difficulties.

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Introduction

Mathematics education is central to the scientific development of a country. The more mathematically enlightened a society is, the better the chances of its citizens are getting employed, increasing their income opportunities, reducing their poverty levels and advancing in science and technology. Being aware of the role of mathematics in national development, the Ministry of Education have made provisions to provide her citizens equal access to quality mathematics education at all levels in the country. These provisions are captured in the Education Strategic Plan (2018 – 2030) of the Ministry of Education that has a strategic objective as to improve quality teaching and learning in Science, Technology, Engineering, Mathematics (STEM) education in all Senior High Schools in Ghana (National Development Planning Commission [NDPC], 2018).

STEM disciplines share the conceptual process of learners making sense what they learn as they individually or in a group, as they actively engage with the environment to explore, test, refine, develop, and use ideas together meaningfully (Li & Schoenfeld, 2019). STEM education aims at developing processes and skills for solving problems. The focus is on challenging learners to think critically and to come out with their own solutions novel problems and thereby making them innovators. STEM skills boost students' project management skills especially in mathematics and engineering courses. For example, building a simple robot, engine or computer involves many processes and management of resources. In the building process, Students acquire skills on how to manage resources in such projects. These skills assist students throughout their lifestyle.

The Senior High School mathematics teaching curriculum is structured to cover seven domains including algebra and trigonometry. Trigonometry is a branch of mathematics that deals with the understanding of triangular concepts and their applications (Rizkianto, Zulkardi, & Darmawijaya, 2013; Ahamad, et al. 2018). Trigonometry in the Ghanaian mathematics curriculum covers angles, measurement of angles, triangles and their relationships. It blends geometric, graphical, and algebraic reasoning to provide space for making sense in solving problems involving triangles, trigonometric expressions and graphs. Trigonometry in the Elective mathematics curriculum is taught in the second year (Form Two). In the Core mathematics curriculum, trigonometry is in two parts: Trigonometry I and Trigonometry II. Trigonometry I (Triangle Trigonometry) is taught in Form Two to enable students identify trigonometry ratios (sine, cosine and tangent) and their application to calculate distance and heights. Trigonometry II (Trigonometry function graph) is taught in Form Three to enable students draw the graphs of trigonometric functions and use them in solving problems. In addition to these objectives, teaching trigonometry in the elective mathematics curriculum is also to enable students convert angles into radians, state and use the sine and cosine rules, and apply them solving problems involving bearings equations (up to quadratic). Trigonometry is a product of algebraic techniques, geometrical realities and trigonometric relationships (Niranjan, 2013). Sound knowledge in trigonometry that is required to represent and solve problems in geometry and in daily life situations. 0ne of the most frequent trigonometry relation used in solving problems in geometry is the Sine rule. Teaching and learning of the sine law require a combination of approaches for effective formation of concepts and understanding.

In the SHS mathematics curriculum, the sine rule and its applications are taught at form two level This rule establishes a relationship between the angles and the side lengths of any given triangle. This rule state that given a triangle ABC with sides x, y, and z, as in

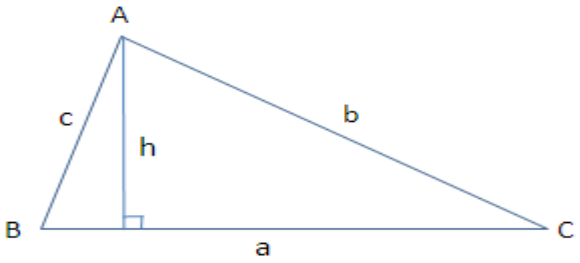

Fig. 1: Triangle ABC

Then, taking projection of both AB and AC on *h* gives:

c.sin $B = b.sinC$

Dividing through by sin B $and\ then\ sinC$

Therefore, $\frac{b}{SinB} = \frac{c}{SinC} = \frac{a}{SinA}$

Taking another projection of CA and CB on the height *h also gives*

a.sin $B = b.sinA$

Hence Sine Rule is stated as $\mathbf{\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC}}$

The curriculum does not explicitly explain how teachers teach and use the Sine Rule but there are problem situations that require its application for resolution. Besides, the relevance of learning Sine Rule cannot be overlooked as it has direct applications in Geography and used widely in other fields of Geometry, Cartography, Geology (Weber, 2005; Tuna, 2013) and flight engineering.

Researchers (Brown, 2006; Weber, 2005; Presmeg, 2007 & Orhun, 2013) have examined students' misconceptions, errors, and related to learning complexities about simplification of trigonometric expressions, metaphors and students' understanding of the sine and cosine. These studies indicate that many students had an incomplete or fragmented conceptual understanding of the three major ways of visualising the sine and cosine namely: as coordinates of a point on the unit circle, as a horizontal and vertical distances that are graphical entailments of those coordinates, and as ratios of sides of a reference triangle. Research that examined the challenges in learning has shown that many students experience difficulties in learning geometry and trigonometry (Alex & Mammen, 2012; Abu & Abidin, 2013) and do not develop the concepts of trigonometry in solving trigonometry problems (Orhun, 2015). These situations that lead to student poor performance in problems involving trigonometry concepts.

In Ghana, Nabie, Akayuure, Bariham, and Sofo (2018) study of pre – service teacher's perceptions and knowledge of trigonometric concepts suggests that participants perceived trigonometry as abstract, difficult and boring to learn. They also had limited conceptual knowledge of basic trigonometrical concepts. Based on the findings, they recommended that teacher education must change their instructional practice and teach mathematics for understanding ~~if~~ to achieve the goal of quality mathematical education as emphasised in the curriculum. Teaching trigonometry for understanding requires the use of active techniques that enable learners to construct their own knowledge, reflect on what they doing and how their understanding is changing.

Theoretical Framework

This study is grounded on constructivism. This theory advocates active teaching techniques and is a widely touted theory of learning that encourage students to learn on their own. It's principles probe understanding on grounds that understanding can increase and change to higher level thinking based on experiences (Mvududu & Thiel-Burgess, 2012) The main idea of constructivism is that learners actively construct new knowledge on the foundation of pre-existing knowledge (McLead, 2019). The principles of the constructivism suggest that students can make sense of the materials they learn if they are actively involved and act based on their experiences. Teachers should consider what students know and allow them to put their knowledge into action. Such knowledge in action learning trigonometry enable the student to build new concepts that make sense to them. Through active classroom participation and interactions, students are able to participate in problem solving strategies, verbalize their thinking, explain or justify their solutions and ask for clarification. This enables the students to understand the concepts and extend their conceptual frame to accommodate alternative methods of solving trigonometry problems. In a constructivist learning environment, the teacher guides the students through problem-solving and inquiry-based learning activities with which students put their ideas together, draw conclusions and make inferences as a group and share their knowledge in a collaborative learning environment. Always guided by the teacher, students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook. The task of the instructor is to translate information to be learned into a format appropriate to the learner's current state of understanding (Khalid & Azeem, 2012).

Constructivists view students as actively engaged in making of what they learn. Teaching trigonometry using the constructivist approach enables the teacher to assess what students can analyze, investigate, collaborate, share, build and generalise based on previous knowledge, rather than what facts, skills and processes they can produce. To do this effectively requires teachers to use innovative teaching methods that respond to emerging issues in mathematics education such as modeling. The 5E instructional model features all the characteristics epitomised in constructivism and provide opportunities for learner participation by engaging them in activities that enable them to construct their own understanding. In this way, teachers facilitate and guide students to make sense of what they learn.

The 5E instructional model, developed by a Biological Sciences Curriculum Study (BSCS) team (Bybee et al., 2006) within the constructivist frame, expands and deepens curriculum and instruction for improved student learning. It provides an instructional strategy that encourages a constructivist approach to education while introducing aspects of behaviorism and cognitivism (Jobrack, 2010). The model has five learning phases/stages all beginning with 'E' – Engagement, Exploration, Explanation, Elaboration, and Evaluation, and hence its name.

Engagement: This phase focus students' attention on the topic and attempts to capture their attention and interest. Consequently, activities focus students' attention on the learning situation, event, demonstration, or problem. Teacher asking questions, posing a problem, or presenting a discrepant event are strategies to engage learners to focus attention (Bybee, 2014). The engagement phase is student-centered and minds-on stage intended to create and develop learners' interest, and to occupy their minds on the topic and what lies ahead in the lesson.

Engagement should persuade and convince learners about the reason they should learn the topic (Dass, 2015). In this phase, past experiences are connected with actual classroom learning experiences. Students ask questions and try to find answers to them. For teachers, this phase provides opportunities for determining their students' misconceptions (Balci, 2005).

Exploration: At this stage, exploratory activities are designed for introducing and describing–exploratory experiences of concepts, practices and skills of the instructional sequence (Bybee, 2014). Students acquire experiences-to formulate explanations, investigate phenomena, observe patterns, and develop their cognitive and physical abilities. The teachers' role in this phase is to introduce the activity, describe the appropriate background, provide adequate materials, and counter any inherent misconceptions. After this, the teacher assumes a passive role and paying attention to details, observing, directing students as they clarify their understanding and assisting them in the reconstructing concepts whiles developing their abilities.

Explanation: This is a teacher-centered phase in the model because teachers become active in correcting mistakes and completing the missing parts of students' work Duran (2004) described this phase as the "minds-on" phase that is more teacher-directed and guided based on students' prior experiences. Prior experiences are used as contexts of the explanation (Bybee, 2014) and methods are chosen to lead students to define their work or to explain their results. Supportive learning tools like videos, power-point presentations or role-plays (Mulder, 2019) may be used to help learners to clearly grasp the new concepts.-Formal mathematical definitions and explanations are provided by the teacher. The ultimate aim of the teacher is to cultivate in learners' the correct use of mathematical terms, develop their listening and oral skills in describing the observations in the exploration phase and providing answers and solutions to the lingering questions through interactive engagement (Dass, 2015).

Elaboration: In this phase, students practice their new knowledge, suggest solutions, create new problems and make decisions and/or introduce logical implications. This is achieved by presenting a new mathematical activity or by extending the activities done in the exploration phase (Wilder & Shuttleworth, 2005). The motive is to orchestrate the transfer of concepts and abilities to related, but new, situations (Bybee, 2014). Students are advised to inquire for understanding from their peers or to come up with new ideas or strategies based on the new skills they have learned. They present and explain their final situations and activities that are used as basis for evaluation (Dass, 2015).

Evaluation: This is the last phase of the model where the teacher involves students in experiences that are understandable and in lieu of those of prior phases and matching the explanations (Bybee, 2014). Assessment in this phase is in an inquiry-based procedure that is different from that in conventional lessons. The evaluation phase is important in determining whether or not concepts are learned correctly in the mathematical context. Evaluation which can be formal or informal (Wilder & Shuttleworth, 2005) are used for revealing students' constructed knowledge in their responses to oral questions, making short summaries, filling out empty maps, reading graph and evaluating tables. Evaluation is both a separate phase and an activity that applies throughout other phases in the learning cycle (Dass, 2015). A diagrammatic of the 5E learning model is presented in figure 1

Figure 2. Phases of 5E Learning Cycle Model (Tuna & Kacar, 2013, p. 76).

Motivation is a series of attempts to provide certain conditions, so that one wants and wants to do something, and if one does not like it, it will seek to nullify or circumvent those feelings of dislike (Creswell, 2012). Aminudin et al (2019) study on why students fail to think when solving problems on trigonometry revealed that motivation solve math problems in trigonometry was limited. He recommended teaching trigonometry based on Maslow's theory of need about self-actualization and self-esteem. The need for self-actualization is demonstrated in the 5E Instructional Model where students are allowed to construct their ideas through the full use of cognitive ability to solve a given mathematical problem.

Cazibe YİĞİT (2011) also investigated the motivation to improve writing skills among a group of students in three different classes which consisted 70 students at Trakya University, School of Foreign Languages through the 5E Model-based Writing Instruction. The students were given a pre-test before the implementation in order to determine how successful they were in writing skill and then they were given the same test at the end of the study as a post-test in order to find out how much they could improve their writing skill. Several studies have revealed that mathematics performance is highly affiliated to students' motivation towards mathematics achievement (Mullis, Martin, Foy & Arora, 2012; Pantziara & Philippou, 2013; Yu & Singh, 2016). According to Kurumeh, Achor, Akume and Mohammed (2012), many students are not interested in mathematics and what it can offer. In many cases, students tend to fear and dislike the subject since they are not motivated to learn. It is argued that this lack of motivation leads to large number of failures in mathematics examinations which in tend create a problem.

Statement of the Problem

Research studies (Moore, 2012; Cetin, 2015) revealed that students have difficulties in learning trigonometry. These difficulties emanate from a number of factors including lack of motivation, abstractness of trigonometric concepts, lack of understanding of fundamental concepts, and students' inability to connect concepts in trigonometry to their everyday life. In Ghana, Mensah (2017) study reported that students are generally susceptible to errors in solving problems in trigonometry. In addition, Nabie, Akayuure, Bariham, and Sofo (2018) study of pre – service teachers in Northern Region of Ghana suggest that trigonometry is perceived as abstract, difficult and boring to learn. They also had limited conceptual knowledge of basic trigonometrical concepts. Also, the SHS Examiners Reports consistently suggest that many students lack in-depth knowledge of trigonometric equations involving double angles and have difficulties in solving problems involving trigonometry concepts (WAEC Chief

Examiners' Reports, 2011; 2012; 2013; 2016; 2016; 2017). Specifically, the reports consistently indicate that many students have difficulties in solving problems involving (a) non - right angled triangles where one side of the triangle is given, (b) problems involving bearings and (c) angles of elevation and depression. If these problems are not resolved, it would continually affect students understanding in areas of bearings, other areas of physics and many branches of engineering

The 5E model learning cycle which have been used in teaching different scientific concepts (Akar, 2005; Ceylan, 2008) and mathematics concepts (Pulats 2009) is found to improve students' achievements and aids in the retention of new learnings (Tuna & kacar, 2013). However, there is limited knowledge on the effect of this model in addressing student's difficulties in trigonometric concepts. Generally, the literature on the use of this model in the Ghanaian mathematics classroom is limited. Hence, the need to investigate the efficacy of the 5E model on the sine rule, in the Ghanaian classroom.

The research was to investigate the effect of using 5E instructional model on Senior High School students' mathematical achievement in the use of the application of sine rule in problem solving. The study also explored students' common difficulties with use of the sine rule the effectiveness of the 5E instructional model in addressing student difficulties and motivating effect of the model on learning and applying the sine rule. In pursuance of the objectives, the study was designed to answer the following research questions:

1. What are the common difficulties of Senior High School students in applying the sine rules in solving problems?
2. What is the effect of using 5E instructional model on Senior High students' performance in applying the sine rule in problems involving?
3. How does the use of 5E instructional model motivates students to learn and use sine rule in solving problems?

Method

Design

The study employed the embedded mixed method approach with quasi-experimental group as a strategy of enquiry based on our understanding that no single data set is sufficient to answer all the research questions that are different in nature (Creswell, 2012). Non-equivalent control group pre-test--post-test design under quasi-experimental group was used. This design was used in order not to disrupt natural classes and the students are considered to share similar characteristics (Best & Kahn, 2006). A diagrammatic representation of the non-equivalent pre-test--post-test control group design is represented in figure 3:

The pre-test O1 was administered to both the experimental (A) and control (B) groups to determine the entry point of participants before treatment. The experimental group received 5E Instructional model lessons (X) while the control group underwent conventional instruction (C) after which a post-test (O2) was administered to both groups to measure the student achievement resulting from the different teaching methods (Creswell, 2012).This

design enabled a control group to be compared with an experimental group in the application of the sine rule in solving problems. Both groups took a pre-test and post-test, however, only the experimental group received treatment on the 5E instructional model. The pre-test provided the researcher with some idea of how similar the control and experiment groups were before the treatment.

Group	Pre-test	Treatment	Post-test
A	O1	Y	O2
B	O1	C	O2

Time →

Fig. 3 Non-Equivalent Pre-Test--Post-Test Control Group Design

The population for the study was government assisted Senior High School students in Bekwai Municipality of the Ashanti Region of Ghana. These schools use the national mathematics curriculum and run the same academic calendar. The students admitted to these schools had passed their Basic Education Certificate Examination (BECE), and therefore have the ability to learn trigonometry in the mathematics teaching syllabus. The ages of Senior High School students in Ghana are between 15 and 20 years. Convenience sampling was applied to select 80 (57 males; 23 females) General Science students from one out of the two mixed assisted government SHSs in the Bekwai Municipality. Convenient sampling technique was used for the sample on the basis of the accessibility. Two intact third year, classes 3E and 3F, were used as the Control and Experimental groups respectively for the study. The control group of 40 students was made up of 29 males and 11 females while the experimental group 40 students comprised of 27 males and 13 females. Students from all the selected classes grades in their second semester, form two Elective Mathematics subjects ranges from AI to C6.

Two instruments: Trigonometry Achievement Tests (pre-test and post-test) and a Questionnaire (closed ended and open ended) were used to collect data for the study. The Trigonometry Achievement Test was comprised the Pre-test and Post-test. The pre-test was made up of eight (8) items on problems to be solved by the use of sine rule. The first four items centered on the identification of sine rule to solve problems of lengths and angles of triangles. The last four items involved applications of sine rule in solving problems on bearings, angle of elevation and depression, designed by the lead author to collect data for research one (1). The post-test, also made up eight (8) similar items on sine rule, was developed to collect data to measure the learning outcomes of the students' ability to apply sine rule in solving problems. The post-test was designed to answer research two (2). The pre- test items were different from the post-test to avoid providing clues to the latter. All the items were drawn from SHS mathematics curriculum materials especially the teaching syllabus. In all 8 items each for pre-test and post-test were used to measure the profile dimensions: knowledge, Understanding and Applications.

The questionnaire was a five-point Likert scale type items based on 5E learning model. It was used to collect data on student's reactions, attitudes, motivation, interest and perceptions in learning trigonometry taught through the model. The questionnaire was in three sections: A, B and C. Section A of the questionnaire was made up of three

items designed to collect demographic information of participants. Section B made up of ten closed-ended items explored participants perceptions, interests, attitudes and motivation to learn trigonometry questions. Section C consisted of (2) opened-ended questions constructed to elicit information on how the 5E Model motivates students after experiencing it in lessons on sine rule and its application.

Validity and Reliability of the Instrument

The tests were validated by having colleague teachers review the items with respect to course objectives stated in the syllabus. This was followed by consultation with experts in the field of mathematics education including three lecturers at the department of Mathematics Education of the University of Education, Winneba (UEW). Furthermore, the tests were piloted on 48 students selected from a similar school in the district mainly to detect lack of clarity in the phrasing of the questions, and to give indication for the appropriateness of time needed for its completion.

Reliability on the other hand means dependability or consistency of results on many occasions. It refers to the extent to which a measuring instrument; a questionnaire, a test yields the same results on repeated applications (Williams, 2014). It means the degree of dependability of a measuring instrument. In this study, the split-half method was used to check the reliability of the instruments. The spilt-half method requires the construction of a single test consisting of a number of items. These items were then divided or split into two parallel halves (usually, making use of the even-odd item criterion). According to Gay and Airasian (2003), for a cognitive test in which the questions are not scored dichotomously the reliability can be calculated by using the Spearman Brown formula $R = 2r/(1+r)$, where r is the correlation coefficient between split half test results, or between test and the re-test results, or between two equivalent randomly assigned groups. The results in this study showed significant correlation coefficient of 0.59 given R as 0.748.

The pre-test and post-test were both administered under same conditions before and after treatment respectively. The pre-test lasted for 40 minutes on Monday, 18th of March 2019 in the second semester of the 2018/2019 SHS academic calendar. The pre-test was marked and scored on the following day where data was retrieved. The experiment followed the pre-test on Monday, 25th of March 2019. Post-test was conducted on Tuesday,2nd April, 2019 after the treatment which lasted for 40 minutes. Data was compiled from the post-test scores after marking The Trigonometry Achievement Tests (TAT) were meant to be written by all participants in the study. Time to complete each test was forty (40) minutes. Marking schemes were prepared separately for the two tests and all participants' answer sheets from TAT was marked and scored by the researcher. Both the pre-test and the post-test were scored out of fifty (50) marks. Hence a participant can obtain a minimum of zero and a maximum of fifty marks. Each item carried a different mark for both pre-test and post-test.
After the treatment, questionnaires were administered to students in the experimental group at their usual classroom. Participants completed the questionnaires on the spot within 30 minutes and turned them in resulting in a return rate of 100%.

A total of three periods (one period for 60 minutes) amounting to 120 minutes of mathematics lesson was used to

implement the experiment which involved the five phases of the 5E instructional model. The intervention took three days to complete. During the treatment, the experimental class was taken through lessons on the sine rule by employing the 5E instructional model while the control group was taken through the same lessons using the traditional approach. In the control group, the students were taught the same topics (as in the experimental group) but with traditional approaches such as the lecture method in which the learners strictly follow the instruction the researcher gives and active participations was not promoted. The students were not given any hands-on activities to help them explore sine rule under trigonometry concepts and form their own knowledge. The sine law was given to students without any explanation. In other words, trigonometry instruction was not in line with the 5E Learning Model but mainly in lecture format and therefore instruction was teacher-centered. The 40 students in the control group were not put into groups. Their lesson was taught in the same week as in the experimental group in second semester.

Data Analysis

Data collected involved both quantitative and qualitative data. Quantitative data collected from the scores of pre-test and post-test were analyzed by employing and descriptive and inferential statistics respectively using Statistical Package for Social Sciences (SPSS) version 21.0. Measures of central tendencies and measures of dispersion were employed to understand how one score compares with another while independent samples t-test were run to compare for any significant difference in the scores of the experimental and control groups at 95% confidence level. Again, descriptive statistics was also used to analyze the closed- ended part of the questionnaire in the form of simple percentages. For the qualitative data, the process of data analysis involved was thematic, where research findings were interpreted with reference to data gotten from open-ended questionnaires. Data collected were analyzed by themes that run through the responses of the open-ended data from the questionnaires after the researcher had read the and identified categories of responses that answered the research question.

Results

The results were presented based on the research questions that guided the study. The quantitative data generated from the pre-test, post-test and closed ended questionnaire were analyzed using both descriptive and inferential statistics. The qualitative data generated from open- ended questionnaire was analyzed using thematic analysis.

Quantitative Data

Research Question One

Research question one focused common difficulties of Senior High School students in the application of the sine rule in solving problems. To answer research question one, students' answers to pre-test questions were scored item by item and the results presented in Tables 1 and 2.

Table 1. Item by Item Comparison of Pre-Test Results of The Experimental Group

Item	Correct (%)	Partially Correct (%)	Wrong (%)	No Attempt (%)	Total (%)
Q. 1	12 (30%)	5 (12.5%)	23 (57.5%)	0 (0%)	40 (100%)
Q. 2	20 (50%)	5 (12.5%)	13 (32.5%)	2 (5%)	40 (100%)
Q. 3	15 (37.5%)	3 (7.5%)	24 (60%)	8 (20%)	40 (100%)
Q. 4	4 (10%)	3 (7.5%)	15 (37.5%)	18 (45%)	40 (100%)
Q. 5	2 (5%)	9 (22.5%)	9 (22.5%)	20 (50%)	40 (100%)
Q. 6	0 (0%)	2 (5%)	14 (35%)	24 (60%)	40 (100%)
Q. 7	2 (5%)	0 (0%)	7 (17.5%)	31 (77.5)	40 (100%)
Q. 8	1 (2.5%)	5 (12.5%)	7 (17.5%)	27 67.5%)	40 (100%)

Table 2. Item by Item Comparison of Pre-Test Results of The Control Group

Item	Correct (%)	Partially Correct (%)	Wrong (%)	No Attempt (%)	Total (%)
Q. 1	17 (42.5%)	7 (17.5%)	16 (40%)	0 (0%)	40 (100%)
Q. 2	27 (67.5%)	5 (12.5%)	5 (12.5%)	3 (7.5%)	40 (100%)
Q. 3	10 (25%)	10 (25%)	20 (50%)	0 (0%)	40 (100%)
Q. 4	13 (32.5%)	5 (12.5%)	12 (30%)	10 (25%)	40 (100%)
Q. 5	5 (12.5%)	9 (22.5%)	11 (27.5%)	15 (37.5%)	40 (100%)
Q. 6	0 (0%)	6 (15%)	5 (12.5%)	29 (72.5%)	40 (100%)
Q. 7	0 (0%)	4 (10%)	8 (20%)	28 (70%)	40 (100%)
Q. 8	1 (2.5%)	3 (7.5%)	10 (25%)	26 (65%)	40 (100%)

From Table 1, it would be realized that, apart from question two, only 30%, 37.5%, 10%, 5% of participants in the experimental group answered correctly questions one, three, four and five respectively. Similarly, from Table 2 it would be realized that, apart from question two, only 42.5%, 25%, 32.5%, 12.5% of participants in the control group answered questions one, three, four and five respectively correctly. These results indicated poor understanding of basic trigonometry concept in sine rule. It was therefore not surprising that about 45% and 50% in the experimental group (see Table 3) did not attempt questions four and five respectively while 25% and 37.5% in the control group did not attempt questions four and five respectively. Also, it would be realized that most of the students who attempted questions (1, 3, 4 and 5) either had them wrong or partially answered them correctly.

The results from Table 1 also revealed that most students answered question two correctly. Twenty (20) participants representing 50% in the experimental group and (27) participants representing 67.5% in the control group answered question two correctly. A careful analysis of students' answer scripts showed that the students

performed better in question two as a result of using other rules such as Pythagoras' theorem and trigonometry ratios instead of sine rule to solve the right-angled triangle. However, a whopping 32.5% and 12.5% from the experimental and control groups still answered this question wrongly. These results showed that majority of the students did not have basic conceptual understanding of trigonometry especially Sine rule.

Results from Table 1 indicated that only two students representing 5% of the participants from the experimental group answered question seven correctly while one student each representing 2.5% from both groups answered question eight correctly. It is surprising to note from Table 1 and 2 that, no student from both groups answered question six correctly. The results also revealed that majority of the participants ranging from 65% to 72.5% in the control group and 60% to 77.5% in the experimental group did not even attempt these questions while most of those who attempted had them wrong (12.5% to 25% in the control group and 17.5 to 35% in the experimental group) and few had them partially correct (17.5% to 15% in the control group and 0% to 12.5% in the experimental group). A further investigation of participants' responses indicated that most of the students who attempted these questions could not translate the word problems into accurate diagrams in order to apply the required trigonometric rules. This result is troubling as over 60% of the participants from both groups did not attempt these application questions.

To determine the difficulties students' encounter in trigonometry questions, the self-constructed responses to the pre-test were assessed using as assessment rubrics as follows: poor conceptual knowledge of basic trigonometry, inability to view sine rule as ratios of sides of a reference triangle, limited conceptual knowledge in geometry and inability to apply knowledge in trigonometry to solve practical questions. The results of the assessment were presented in Table (3).

Table 3. Students Difficulties in Solving Problems Involving the Sine Rule

Common Difficulty	Control **f (%)**	Experimental **f (%)**
Poor conceptual knowledge of basic trigonometry	35 (87.5%)	38 (95%)
Inability to view sine rule as ratios of sides of a reference triangle	35 (87.5%)	38 (95%)
Limited conceptual knowledge in trigonometry	39 (97.5%)	39 (97.5%)
Inability to apply knowledge in trigonometry to solve practical questions	40 (100%)	40 (100%)

From Table 3 shows that students generally had difficulties in solving trigonometric problems as over 85% of students in both control and experimental groups have challenges in the domains assessed. All the participants in both the control and experimental groups (100%) were unable to apply trigonometry in solving practical problems, 97.7% in both groups had limited conceptual knowledge of geometry. Equal proportions of participants (87.5%) in the control group had poor conceptual knowledge trigonometry and lack the ability to view the sine rule as a ratio of the sides of the sides a triangle and so is the proportions of participants in the experimental group (95%)

Research Question Two

Research question one focused on the effectiveness of using 5E instructional model on Senior High students' performance in problems involving sine rule teaching and learning in contrast to conventional instruction on students' achievement in sine rule. The pre-tests of both the control and experimental groups were compared using independence samples t-test at 95% confidence interval to ascertain whether there was significance difference in the achievement of the control and experimental groups before the treatment. The descriptive statistics (see Table 4) of the pre-treatment achievement scores of the two groups is presented below.

Table 4. Descriptive Statistics of Pre-test Scores of Control and Experimental Groups

	N	Minimum	Maximum	Mean	Std. Deviation
Control group	40	4	40	17.48	8.12
Experimental group	40	0	33	10.18	8.23

From Table 4, the results showed a mean score of 10.18 and 17.88 respectively for the experimental and control groups with a mean difference of 7.30. The minimum score for the experimental group was 0 while that of the control group was 4. Also, the experimental and control groups scored a maximum mark of 33 and 40 respectively. To test whether the difference in the mean scores was statistically significant, independent samples t-test (see Table 5) was performed at 95% confidence interval.

To test whether there was statistically any significant difference in the pre-test scores of the two groups, an independent samples t-test was performed at 0.05 significance level. The results of the independence samples t-test in Table 5

Table 5. Independence Samples T-test of the Pre-test of Control and Experimental Groups

Groups	N	Mean	Std. Dev.	t-value	df	p-value	Eta Squared
Experimental	40	17.48	8.12	3.995	78	0.000	0.046
Control	40	10.18	8.23				

Table 5 revealed that there was statistically significant difference between the control group $(M = 17.48,\ SD = 8.12)$ and experimental group $(M = 10.18,\ SD = 8.23)$ conditions; $t\,(78) = 3.995, p = 0.000 < 0.05$. The results suggest that the experimental and control groups were not at the same level of achievement before intervention. The mean score of 17.48 by the control group as compared to 10.18 obtained by the experimental group suggests that the control group outperformed the experimental group in the pre-test. The effect size (eta squared value) was calculated and was found to be 0.046 (see Table 5). This eta squared value indicates a small effect size which implies that 4.6% of the variance in the pre-test scores is

elucidated by the independent variable. This result indicates that even though the control group outperformed the experimental group in the pre-test, the extent of the difference between the achievement on the pre-test was small.

Post-test Results for Control and Experimental Groups

Table 6. Descriptive Statistics of Post-test Scores of Control and Experimental Groups

	N	Minimum	Maximum	Mean	Std. Deviation
Control group	40	6	43	20.95	9.995
Experimental group	40	10	50	31.43	9.421

From Table 6, the minimum scores on the post-test were 6 and 10 respectively for the control and experimental groups. Also, the control group had a maximum score of 43 while the experimental group had a maximum score of 50. This result indicates an improvement in the post-test scores for both groups compared to their pre-test scores. Furthermore, Table 10 depicts a mean score of 20.95 and a standard deviation of 9.995 for the control group compared to a mean score of 31.43 and a standard deviation of 9.421 for the experimental group. The results from Table 6 suggests that the experimental group performed better on the post-test than the control group. To ascertain whether the difference in the scores was statistically significant, the following hypothesis was formulated:

Hypothesis Testing

Ho: There is no statistically significant difference in the mean performances of the experimental and control groups post-test scores in sine rule under trigonometry.

H1: There is statistically significant difference in the mean performances of the experimental and control groups' post-test scores in sine rule under trigonometry.

To test the hypothesis, an independent samples t-test was performed at 95% confidence interval to verify if there was statistically significant difference in the post-test scores of the two groups. The results from the independence samples t-test is shown in Table 7.

Table 7. Independence Samples T-test of the Post-test of Control and Experimental Groups

Groups	N	Mean	Std. Dev.	t-value	df	p-value	Eta Squared
Experimental	40	20.95	9.995	4.823	78	0.000	0.206
Control	40	31.43	9.421				

From Table 7, the independent samples t-test performed on the post-test scores of the control and experimental groups revealed statistically significant difference between the control group $(M = 20.95,\ SD = 9.995)$ and

experimental group $(M = 31.43,\ SD = 9.421)$ conditions; $t\,(78) = 4.823, p = 0.000 < 0.05$. The results suggests that the experimental group outperformed the control group on the post-test conducted after experiment. The mean difference of 10.48 between the experimental and the control group suggests that the experimental group outperformed the control group in the post-test. This difference in achievement between the two groups might be as a result of the 5E instructional model employed on the experimental group during the experiment and the traditional method employed on the control group.

From table 7, the eta squared value was found to be 0.206. This eta squared value showed a large effect size indicating that 20.6% of the variance of the post-test scores were improved by using the 5E instructional model as the experiment. By this eta squared value (0.206), it implies that the difference in achievement on the post-test between the experimental group, where 5E instructional model was used, and the control group, where the traditional approach was used, was large

Research Question 3

Research question three sought to determine how effective the 5E model impart on students' motivation towards the study of sine rule. To answer this research question, a questionnaire was administered to the experimental group where they were taught using the 5E model during the treatment. The questionnaire consisted of three sections, section A, B and C. For section B, the respondents were required to indicate on a five-point Likert scale ranging from strongly agree (1) to strongly disagree (5) their views on the effectiveness of the use of 5E model as an instructional approach. For section C, the respondents were expected to provide written responses to the three opened-ended questions on the effects of 5E instructional model on their motivation to learn.

Analysis of Participants' Responses to Section B Of the Questionnaire

Students' responses to items in the section B of the questionnaire where respondents were required to indicate on a five-point Likert scale ranging from strongly agree (1) to strongly disagree (5) their views on the effectiveness of the use of 5E model as an instructional approach were analyzed. The percentage presentation of the results is shown in Table 8.

From Table 10, it would be realized that apart from 5% of the students who were undecided, the rest (95%) either agree or strongly agree that the use 5E instructional model enhanced their understanding in sine rule under trigonometry. Also, 100% of the respondents either agree or strongly agree that 5E model made them solve sine rule application questions without too much difficulty, increased their motivation in solving problems involving trigonometry, has increased their interest in studying sine rule under trigonometry and is friendly in learning.

Furthermore, 75% of the respondents were of the view that 5E model is the best practical approach in learning sine rule under trigonometry while 20% were undecided and 5% disagree 5E model is the best practical approach. Similarly, 82.5% were of the view that their motivation in learning sine rule was positive and encouraging while 12.5% were undecided and 5% disagree.

Finally, 90% of the respondents agreed that the use of 5E model was effective and has built them a strong background in solving problems relating to bearing, angles of elevation and depression while 7.5% and 2.5% were undecided and disagreed respectively.

Table 8. Percentage Presentation of Respondents' Perception about the Use of 5E Model

		SA (%)	A (%)	U (%)	D (%)	SD (%)
1.	5E model enhances my understanding in sine rule under trigonometry	37.5	57.5	5	0	0
2.	5E model makes me to solve sine rule applications without too much difficulty.	25	75	0	0	0
3.	Learning sine rule in Trigonometry through 5E model is the best practical method	25	50	20	5	0
4.	My attitudes towards sine rule in trigonometry was positive and encouraging	47.5	35	12.5	5	0
5.	The use of 5E model to teach sine rule under trigonometry is highly very effective	35	55	7.5	2.5	0
6.	Learning through 5E model in sine rule increased my motivation in solving problems	25	75	0	0	0
7.	5E model is friendly in learning	25	75	0	0	0
8.	Deducing sine rule formulae is easy after learning through 5E model	35	45	15	2.5	2.5
9.	Interest in sine rule and its application has increased due to 5E model.	55	45	0	0	0
10.	5E model has built me a strong background for sine rule in solving problems relating to bearing, angles of elevation and depression.	45	45	7.5	2.5	0

Key: SA = Strongly Agree, A = Agree, U = Undecided, D = Disagree, SD = Strongly Disagree

Qualitative Data

The written responses of participants to the opened-ended questions in section C of the questionnaire were analyzed based on the themes that run through them.

Most of the students were of the view that the 5E instructional model has helped them understand sine rule and its applications better and see the method as very effective approach. When asked to comment on how they find the use of the 5E instructional model in learning sine rule and its application in the questionnaire, one of the respondents wrote that "*the lesson was very interesting and I understood everything you taught us in the class*". Responding to the same question, another respondent noted:

> *I see the 5E instructional model as a very simple way of teaching sine rule for students to understand and solve questions correctly without finding it difficult.*

In another response, the respondent stated that "*I find this trigonometry lesson interesting and free from fear and confusing because I am free to ask questions from group members and the teacher*". Continuing, the respondent wrote that "*during the group activities, my friends explain certain things I don't understand to me*".

The responses of the participants suggest that they enjoyed the lessons taught by the use of the 5E instructional model and were of the view that 5E instructional model is an effective approach of teaching trigonometry. This is in line with Praveen and Leong (2013) who found out that social interaction between pupils help to develop knowledge.

Also, participants' responses to the question on how they were motivated to study trigonometry by the use of the 5E model indicated that, the 5E instructional model provide an atmosphere for engagement, discussions, fun and practical activities. These attributes of the 5E model, in the view of the students, motivated them throughout the intervention stage. When asked how the use of the 5E model motivated him to study sine rule, one respondent stated that:

> *Ever since you started teaching us with this method, I always wanted to come to class for trigonometry lessons. Also when I go to the dormitory, l always solve questions from my textbook on trigonometry.*

A second respondent, stated that "*this method of teaching trigonometry has made me to like the topic unlike first that I don't like trigonometry at all*" some of the respondents stated that the use of the 5E instructional model has led to an increase in their study time because of its motivational attributes. According to them, their personal study time for mathematics has increased because the 5E model made the lesson interesting and practical hence making them want to study more mathematics. When responding to the question on how the use of the 5E model motivated him to study mathematics, one respondent was of the view that "this method has made learning of trigonometry so fun that my study time for mathematics has increased from twice in a week to four times in a week". Another respondent was in support of this view when he stated that

> "*yes I have really enjoyed the lessons we had with this method because it was full of practical activities in a friendly atmosphere. Because of this, now I study mathematics more than previously".*

Furthermore, the participants stated that the use of the 5E model has improved their application of sine rule in solving questions involving angles of elevation and depression. This improvement was observed in their post-test scores where most of the participants attempted application questions unlike the pre-test where majority did not attempt application questions. Commenting on how the use of the 5E model improved the way he solved application questions, a participant stated that:

> *In the pre-test, I did not even attempt any application question but after you took us through the lesson using this method, 5E model, I attempted all the application questions in the post-test and I know I will get them correct.*

In his response, another participant stated that "*for the first test we did, I did not solve any application question but the second test I solved two out of the three application questions*". Another respondent was of the view that the use of the 5E model made her understanding of the concept better when she stated "*In fact, for the first time, I understand these concepts better and learning has been made easier because now I don't need to do "chew and pour" as I used to do*"

Adopting engaging tools in the classroom, teachers may be able to transform feelings about learning and Mathematics by changing the focus from teaching facts and skills to building positive relationships between learners and Mathematics. From the above responses, it was concluded that the respondents were of the view that

the use of the 5E instructional model was fun, practical, interactive and interesting hence they were motivated to study trigonometry, specifically sine rule.

Discussion

The findings to the first research question indicated that SHS students encounter some difficulties in solving questions involving trigonometry specifically, the sine rule. These difficulties include; poor conceptual knowledge of basic trigonometry, inability to view sine rule as ratios of sides of a reference triangle, limited conceptual knowledge in geometry and inability to apply knowledge in trigonometry to solve practical questions. Statistics from the pre-test responses of participants revealed that students were not able to write accurate sine rules for reference triangles and could not solve application questions involving trigonometry. These findings resonate strongly with the study by Brown (2006), which found that many students had an incomplete or fragmented understanding of ways to view sin e as ratios of sides of a reference triangle. Also, the results are in line with the findings from a study by Nabie, Akayuure, Bariham, and Sofo (2018), which found among other things pre – service teachers, who were admitted directly from the SHS level, perceived trigonometry as abstract, difficult and boring to learn and had limited conceptual knowledge of basic trigonometrical concepts. Furthermore, the results resonate with the study by Orhun (2015), who studied the difficulties faced by students in using trigonometry for solving problems.

Also, the findings from the independence samples t-test performed on the pre-test scores of control and experimental group revealed a significant difference in the mean scores, where the control group was on a higher achievement level in trigonometry than the experimental group. However, results from the independence samples t-test performed on the post-test scores of the two groups indicated that the experimental group outperformed the control group after intervention. These findings showed that the use of the 5E model applied to the experimental group during intervention improved their performance significantly to have outperformed the control group who were on higher achievement level in the pre-test. This finding is in line with the study by Tuna and Kacar (2013) who found that the use of 5E instructional model improves students' achievement and assists them retain new learning in trigonometry.

Finally, statistics from questionnaires administered to the experimental group after intervention revealed that the use of the 5E model made them develop positive attitudes towards the study of trigonometry. thus about 83% of the respondents agreed that they had positive attitudes towards trigonometry after the use of the 5E model. This positive attitude reflected in their performance in the post-test. This was alluded to by Addae and Agyei (2018) when they revealed that students' attitudes determine the effort they put in in learning a subject and encourage mathematics teachers to strive to sustain students' positive attitudes towards mathematics for good performance. The responses suggest that the way learners feel about Mathematics profoundly influences what they do with it and how they reflect on it, which in turn influences how knowledge grows and connects. The responses resonate strongly with that of M. Aminudin et al (2019) that motivation connect deeply with learner's passions and interests in learning trigonometry. 5E model was also found to be very practical, develop confidence in students, friendly and increase students' interest in trigonometry as alluded to in the responses of the participants. These findings

also resonate strongly with the study conducted by Tabi and Boadi (2014), who found that teachers'' teaching approach affect student's interest and attitudes in teaching mathematics.

Conclusion

This research study investigated the effects of the 5E instructional model on SHS students' achievement and motivation to the study of Trigonometry in relation to sine rule. The study also explored the difficulties that SHS students face in the study of Trigonometry. In this study, participants in the experimental group were taught lessons in trigonometry, specifically the sine rule, by using the principles of the 5E instructional model which their counterparts in the control group were taught lessons using the traditional approach. Students' responses to the pre-test revealed some difficulties they have in answering questions involving the sine rule. These difficulties were revealed from the responses of participants in both experimental and control groups to the pre-test and observation made during intervention. These difficulties include; poor conceptual knowledge of basic trigonometry, Inability to view sine rule as ratios of sides of a reference triangle, limited conceptual knowledge in geometry and Inability to apply knowledge in trigonometry to solve practical questions. Another major finding in this research study was that the pre-test results showed that participants in the control group performed better than those in the experimental group. However, the post-test results revealed the opposite, where the experimental group out-performed the control group after experiment was performed. That is, it can be claimed that the use of the 5E instructional model in teaching trigonometry has a positive impact on the academic achievement of SHS students in trigonometry. The practicality of lessons provided by the 5E instructional model may have contributed to the high academic performance of students taught by this approach. Also, findings from participants' responses to questionnaire items revealed that the use of 5E instructional model has improved their motivation, attitudes and interest towards the study of trigonometry. From students' responses, 5E instructional model was also found to be very practical, develop confidence in students and increase students' interest in trigonometry, specifically sine rule.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Mathematics teachers should adapt the 5E instructional model in teaching trigonometric concepts, especially the foundation concepts in sine rule, to promote retention and transfer of knowledge. This recommendation is made because it was found that students had limited conceptual understanding of basic trigonometric concepts which affected their performance in the pre-test.
2. Appropriate training and in-service training should be provided to mathematics teachers to use and eliminate the difficulties of application of the 5E instructional model in teaching trigonometric concepts. This would provide practical approach to learning, enhance students' engagement and enhance active learning.

Since this teaching method was found to be efficient and led to the improvement of students' performance and motivation in mathematics, curriculum developers should consider emphasizing this teaching and learning

approach in the curriculum.

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A Comparative Study of Student Mathematical Performance in three modes of Teaching and Learning Education during the Covid-19 Pandemic

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Abstract

Due to COVID-19 pandemic many educational institutions worldwide have led to the total closures due to lockdowns and the viral spread of the infections. UNICEF had estimated that more than 92% of the students around the world were unable to attend physical schools due to temporary closures and due to periodic lockdown. This study examined the performance of the students in different learning modalities by comparing their mathematics performances over three consecutive semesters at University of Technology and Applied Sciences, Muscat. Furthermore, the researchers sought to quantify the difference in mathematics performances as indicator of effectiveness of the learning modality in two separate streams of math and non-math core specializations. The analysis was carried out using one-way analysis of variance where the mean mathematics performances was considered as the independent variable and the mode of teaching was the factor. Based on the result of the study, the students' scoring performance in Basic Math to Calculus in the three modes of teaching and learning between the F2F, Blended and Online are not significantly affected. The result reveals that due to the student's high scoring performance in Basic Math to Managerial Statistics in the three modes of teaching and learning between the F2F, Blended and Online are significantly affected. Further analysis, will be investigated in detail to find the affecting factors such as Time Management, Assessment, Home Environment, Collaboration, Homework, Teaching Quality, Skill development, Problem solving ability, Motivation, Help received and Student satisfaction, which made them to score high marks in above said courses.

Keywords: Blended learning, Covid-19 pandemic, Face to face learning, Online learning.

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Introduction

Since the Covid-19 pandemic began in December 2019, there has been a tremendous change in the lives of the people all over the world. The face of education has witnessed a major change that was never seen before. Due to lockdown and spread of the pandemic, various schools, colleges and universities were shut down and the classes were conducted online.

Face-to-face Learning

Face-to-face learning is an educational method in which a group of students is taught course content and learning material in person. This allows a learner and an instructor to engage in real time. It is the most common method of educational instruction. Additionally, learners gain from increased interaction with their classmates. Students are held accountable for their progress in face-to-face learning at the class's designated meeting date and time. Face-to-face learning ensures a greater grasp and retention of lesson content, as well as the opportunity for class members to bond.

Face-to-face learning is primarily a teacher-centered mode of education that varies greatly across cultures. Many modern education systems have essentially abandoned conventional face-to-face learning methods. This is the traditional teaching and learning process. Where the teachers are teaching the students in the class room environment and all the assessment is conducted in person in the campus.

Blended learning

The way blended learning training is given is usually determined by the circumstances, therefore there is no one-size-fits-all solution. Blended learning, also known as hybrid learning, is a type of education that mixes traditional place-based classroom methods with online educational materials and chances for interaction. With the support of Ms. Teams and an E-Learning platform, it's a blend of face-to-face and online instruction. Typically, there is a 50/50 split between face-to-face and online instruction. In online teaching, students are taught the course content by Ms. Teams with a video camera on, and 50 percent of the evaluation is completed remotely online, with the remaining 50 percent completed on campus.

There are several approaches to this form of training. Let's look at some of the most popular blended learning approaches. By providing learners with training materials and presentations prior to the actual class, this blended learning methodology allows trainers to prioritize active learning during class time. The content can be shared via a learning management system (LMS), email, or any other method that the trainer chooses.

This is the structure that comes closest to that of a typical classroom. Learner’s log into a webinar or meeting session, such as a Zoom Meeting, instead of attending in a physical classroom. Learning takes place online, with homework assigned thereafter. An LMS can easily deliver this integrated learning strategy. You can use one to offer a training session and distribute tasks with students before or after the event.

An alternative to full-time online training that allows students to complete the majority of their courses online while simultaneously participating in live webinars with an instructor. The learners' attendance is sporadic and at their choice, giving them the freedom to learn at their own speed. You may make blended learning courses as interactive as you desire. You can choose how much of your learning will be done through online training and how much will be done through self-paced learning. You may, for example, assign learners a job to do before to a live webinar training session. You discuss the task and share solutions throughout the webinar.

Online Learning

The term "online learning" refers to education that occurs over the internet. It's also known as "e-learning," among other things. Online learning, on the other hand, is merely one sort of "distance learning," which refers to any learning that takes place at a distance rather than in a traditional classroom. This type of instruction is conducted entirely online utilizing Ms. Teams. The remote option is used for 50% of the online examination, while the remaining 50% is completed online in Campus. In order to guarantee academic integrity, remote mode assessments are completed with the camera turned on.

Online learning is a type of education in which students learn in a completely virtual setting. Online learning (also known as e-learning) was first introduced in the 1990s with the creation of the internet and was used in distance learning. It allows students from all over the world to connect with academic institutions and other students online and learn at their own pace while working toward a degree or certificate

Online learning is an internet-based learning environment that allows students from all backgrounds and perspectives to connect. A learning management system, or LMS, will be used by a higher education institution to facilitate online learning, which can be asynchronous (where students are not required to be online at the same time and complete coursework using discussion threads and e-mails) or synchronous (where students are required to be online at the same time and complete coursework using discussion threads and e-mails) (where students must be online at the same time).

In the University of Technology and Applied Sciences, Higher college of Technology, the academic year consist of three semesters; September to December, January to April and April to July. Since 2019, the university students had witness three different types of teaching and learning process. i.e., during September 2019 to December 2019, academic year 2019-2020, semester 1, students had a completely traditional face to face education (F2F), during January 2020 –April 2020, academic year 2019-20, semester 2, the students had a blended learning (BLD), which was a mix of face to face and online teaching and learning process and finally from September 2020 to December 2020, academic year 2020-21, semester 1, the students had a completely online teaching (ONL) and learning education. In all the above types of study the assessments and examinations were completed with the highest standard of academic integrity. These student’s data are unique of its kind as there has never been a situation like this in the recent past. The data is significant as these students encountered the three different modes of teaching and learning experience in the consecutive three semesters.

This study intends to compare student's mathematical performance in all the above three different modes of teaching and learning. i.e., face to face, blended learning and online teaching and learning during the course of pandemic. The marks of the students who studied Basic Math, Pure Math, Calculus and Basic Math, Applied Math, Managerial Statistics from the year 2019 to 2021 will be analyzed and their performance will be compared and evaluated with respect to three different modes of education. A survey was also conducted among the above students with respect to their experiences in the three different modes of teaching and learning. The survey was related to Time Management, Assessment - Continuous Assessment (Test/Midterm, Class activity, Self-Study) / Final, Home Environment /Collaboration/Homework, Teaching Quality /Skill development/Problem solving ability, Motivation/Help received and Student satisfaction.

Review of Related Studies

In past may researchers studied the various mode of teaching, learning and its effects on student's performances. Now due to the Covid-19 Pandemic, e-learning has gained a prominent role in the field of the education. Hence many researchers are pursuing their research comparing the different modes of teaching and learning process like face to face (F2F), Blended Learning (the mix of traditional face to face and e-learning) and Online education. Jasmine Paul and Felicia Jefferon (2019) had compared face to face and online education with respect to the student studying environmental sciences and their study reports that there is no significant difference in the F2F and Online education. They also suggest to increase the non-stem majors using flexible online education. Kavitha R. K and Jaisingh. W. (2018) studied Student Experiences in Blended Learning Environments. The study was conducted among undergraduate and post graduate students, the results inferred that blended learning approach is more beneficial for students who are skilled in using certain computer programs and applications. Jeffrey. L. M et al., (2014) studied on How Teachers Balance the Blend of Online and Classroom Components. The result showed that Blended learning will not fulfil its promise of better learning unless teachers can be encouraged to re-think and redesign their courses that afford students more and different learning experiences than those offered by either online or classroom alone.

Darkwa, B.F. and Antwi, S. (2021) the author study aimed to compare classroom learning effectiveness during the coronavirus pandemic to the effectiveness before the coronavirus pandemic at the University of Cape Coast. The performance of students in both teaching and learning modes was also compared. This study was case study research, and both primary and secondary data were employed. The effectiveness was measured using course content, pedagogical approaches, interactivity and assessment, feedback and evaluation. Data on effectiveness was collected using a questionnaire, and students' assessment was used to measure their performance. The data were analysed using a paired-sample t-test embedded in Statistical Package for Social Sciences version 26. The results show that classroom learning was more effective than online learning. Additionally, the students exhibited good academic performance in classroom learning than online learning, although the difference was not statistically significant.

T. Muthuprasad et, at. (2021) focused on understanding Agricultural Student's perception and preference towards the online learning through an online survey of 307 students. The author also explored the student's preferences

for various attributes of online classes, which will be helpful to design effective online learning environment. The results indicated that majority of the respondents (70%) are ready to opt for online classes to manage the curriculum during this pandemic. Majority of the students preferred to use smart phone for online learning. Using content analysis, the author found that students prefer recorded classes with quiz at the end of each class to improve the effectiveness of learning. The students opined that flexibility and convenience of online classes makes it attractive option, whereas broadband connectivity issues in rural areas makes it a challenge for students to make use of online learning initiatives. However, in agricultural education system where many courses are practical oriented, shifting completely to online mode may not be possible and need to device a hybrid mode, the insights from this article can be helpful in designing the curriculum for the new normal.

Foo, Cc et. al.(2021) matched 62 students in each group. With four tutorials, there were 490 observations, with 245 in each group. The mean total score for the DL (distance learning) group which was significantly lower than that of the FF (face-to-face) group. The author noted that students in the DL group had a significantly lower scores for all five areas of proficiency: participation, communication, preparation, critical thinking and group skills. The author concluded that their study revealed that the performance of students utilizing the DL PBL (distance learning problem-based learning) tutorials was lower than that of students participating in the conventional FF approach. Further studies are needed to ascertain the underlying cause.

Jitendra Singh et. al (2021) studied an in-depth review of the history of blended learning, evolution of hybrid model of instruction, preparedness of faculty with minimal or no experience in online teaching, and lessons learned as faculty worked on navigating COVID-19 situation since early 2020. A fish-bone analysis, a visual and structured approach to identify possible causes of problem, has been used to present the problems faced by faculty during the pandemic. A detailed Strength–Weakness– Opportunities–Threat analysis of blended/hybrid learning has been presented. An evidence-based approach on how instructors can combine the best of both traditional and online instruction to offer engaging learning experiences for students

Chisadza. C et.al (2021) investigated the factors that predict students' performance after transitioning from face-to-face to online learning as a result of the Covid-19 pandemic. The study uses students' responses from survey questions and the difference in the average assessment grades between pre-lockdown and post-lockdown at a South African university. The author found that students' performance was positively associated with good wifi access, relative to using mobile internet data. The author also observes lower academic performance for students who found transitioning to online difficult and who expressed a preference for self-study (i.e. reading through class slides and notes) over assisted study (i.e. joining live lectures or watching recorded lectures). The findings suggest that improving digital infrastructure and reducing the cost of internet access may be necessary for mitigating the impact of the Covid-19 pandemic on education outcomes.

Mugenyi Justice Kintu et al. (2017) studied the effectiveness of Blended learning among students and found that the results indicate that some of the student characteristics/backgrounds and design features are significant predictors for student learning outcomes in blended learning. Magaji et al. (2015) investigated the Effect of entry grades on academic performance of students, with particular reference to proficiency in Mathematics and English

Language as requisite condition for student's academic performance in Financial Accounting. The study inferred the following: Gender differences were significant when effect of Mathematics and English language background on academic achievement, there is significant difference occurred when background in Mathematics/English was taken as basis for academic achievement of students in Financial Accounting. The study also showed there was a positive association/relationship between proficiency in Mathematics and English and mean academic performance. The researchers recommended that teachers would need to encourage students in requisite subjects like Mathematics and English as this will aid them in understanding Financial Accounting.

Thelal Iqab Oweis (2018) studied the Effects of Using a Blended Learning Method on Students Achievement and Motivation to Learn English in Jordan. The analysis of Covariance (ANCOVA) revealed statistically significant differences in achievement between the two groups, indicating that the experimental group performed better than the control group. Significant differences were also found in the respective group's motivation to learn English. Arias J et al. (2018) investigated online vs. Face-to-Face: A Comparison of Student Outcomes with Random Assignment. The author showed that Students in the face-to-face section have statistically significantly higher exam scores and statistically significantly greater improvement on the post-test instructor questions. Jeffrey L.

Helm (2014) Comparing Student Performance in Online and Face-to-face Delivery Modalities and found that Online students had significantly lower grade point averages, missed significantly more grade opportunities, and were significantly more likely to fail the course compared to their F2F counterparts. Nigel V Smith (2013) studied on Face-to-face vs. blended learning: Effects on secondary student's perceptions and performance. This quasi-experimental study explored the impact of blended vs. face-to-face tuition over one year in a K-12 school in Auckland. No difference between the classes on any item of assessed work was observed. However, differences emerged between the classes in their perceptions of learning, connectedness, enjoyment and teacher support. Concerns about the effects of technology mediated instruction may be partly allayed by these findings. While the displacement of the teacher from the centre of the learning process may be uncomfortable for teachers, the provision of a rich online learning environment may have positive benefits for students. Many other researchers such as Antonio Jose et al. (2020), Peteros et al. (2020), Lan S (2011), Ruchi Shivam et al. (2015), Shahzad, A et al. (2021) had studied the different modes of education and their impact on student performances. Arias J et al. (2018) investigated online vs. Face-to-Face. Here in this paper, we consider one more mode of study i.e., blending learning. This paper is an analysis of Face-to-Face vs. Blending Learning vs. online. Shahzad, A et al. (2021) study reveal that males and females have a different level of in terms of usage of towards E-learning portals in Malaysian Universities.

In this paper we had considered the situation of COVID 19 impacting the learning process of the students. Our study is the classic example of COVID-19 situation where the student study in three different more of education. Thelal Iqab Oweis (2018) studied the Effects of Using a Blended Learning Method on Students Achievement and Motivation. The authors in the [1, 13, 14] have studied and analyzed either one mode or comparing the two modes of education. Hence there is a significant need to compare the all three different modes of learning which will lead to understand and implement the appropriate modes of learning in appropriate situations.

Significance of the Study

This study examined the performance of the students in different learning modalities by comparing their mathematics performances over three consecutive semesters at University of Technology and Applied Sciences, Muscat. Furthermore, the researchers sought to quantify the difference in mathematics performances as indicator of effectiveness of the learning modality in two separate streams of math and non-math core specializations. The result of this study will exemplify and quantify the most effective learning modality for our students based on their specific specialization stream. In contrast, we will also be able to identify areas where we can improve our course delivery and mainly our course's assessment schemes that is suited for a particular learning modality.

Objectives of the Study

Research Objectives

The objective is to study and analysis whether there is any significant difference in the three mode of teaching which are Face to Face, Blended Learning and Online Teaching based on the student's performance and Learning Education during the period of the Covid-19 Pandemic

Research Questions

- Do we have any significant difference in Student's Mathematical Performance for Face to Face, Blended Learning and Online Teaching and Learning Education while they study from Basic Math to Calculus during the Covid-19 Pandemic?
- Do we have any significant difference in Student's Mathematical Performance for Face to Face, Blended Learning and Online Teaching and Learning Education while they study from Basic Math to Managerial Statistics during the Covid-19 Pandemic?

Hypotheses of the Study

- The mean score of student's performance in the three modes of teaching and learning (Face to Face, Blended Learning and Online Teaching) are considered to be equal.
- There is no significant difference between the mean score of the student's performance in BASIC MATHEMATICS (BM)-F2F (Mode of Teaching), students' performance in PURE MATHEMATICS (PM) - BLD (Mode of Teaching), and students' performance in CALCULUS (CAL)-ONL (Mode of Teaching).
- There is no significant difference between the mean score of the student's performance in BASIC MATHEMATICS (BM)-F2F (Mode of Teaching), students' performance in APPLIED MATHEMATICS (AM)- BLD (Mode of Teaching), and the students' performance in MANAGERIAL STATISTICS (MS)-ONL (Mode of Teaching)

Method

The study was conducted among two different type of specialization such as Information Technology, Engineering and Applied Sciences where student study Basic Math (BM), Pure Math (PM) and Calculus (CAL), Basic Math is perquisite to study Pure Math and Pure Math is perquisite for studying Calculus. Similarly, for specialization such as Business Studies, Photography and Fashion where student study Basic Math, Applied Math and Business Math/ Managerial Statistics (MS). Basic Math is perquisite to study Applied Math and Applied Math is the perquisite for studying Business Math/ Managerial Statistics. The same is given in the figure below.

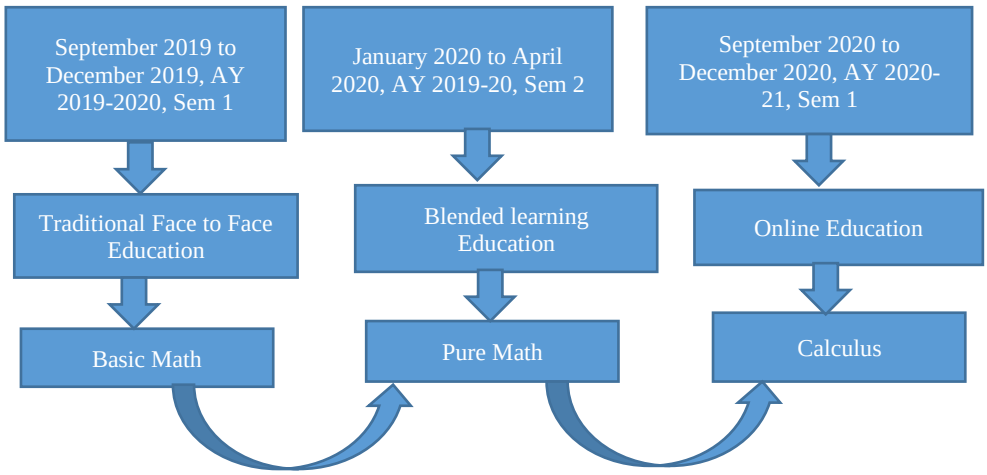

Figure 1. Foundation Math Courses with their perquisite for Information Technology, Engineering and Applied Sciences Department.

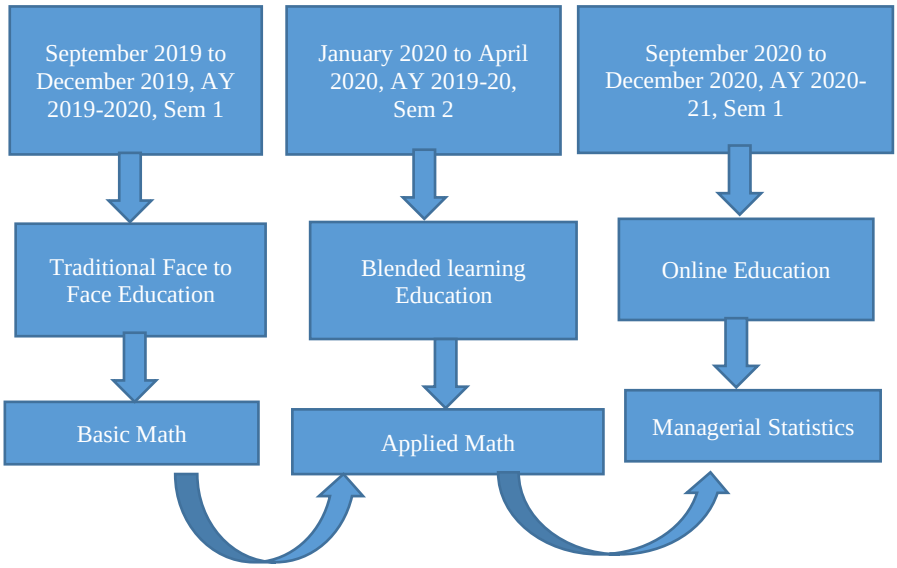

Figure 2. Foundation Math Courses with their perquisite for Business Studies, Photography and Fashion Department

Research Design

This research was anchored in quantitative-descriptive design of research. This research design enabled the researchers to use the existing dataset such as the marks of the students to undergo quantitative analysis and generate important insights out of this. In addition, the design enabled the use of finding statistical significance between and among group means of interest. Compare them simultaneously or pairwise depending on the result of the apriority tests of significance.

Measures

The study used historical pertinent data of the respondents. A permission to use the dataset with a condition of anonymity was established to protect the students' identity and avoid data privacy violations. Marks in Basic Mathematics, Pure Mathematics and Calculus were the main source of data. Validation and inclusion to the final dataset of the study was undertaken by considering respondents with complete marks in these mathematics courses. In addition, marks were courter checked from the result analysis reports which is the main and official database of student's mark.

Mark in these courses were the direct measure of performance of the students on that particular course. As a rule of thumb in education, the higher the mark the better the relative performance of the students in the subject matter. Equivalent grade letter and corresponding grade point average were not considered in the study since previous study suggests that either dataset will result to the same conclusion under the assumption of parametric hypothesis testing.

Population and the Sample

The study sample data (203 students) was collected from the foundation entry level students between the age limit 18 years and 22 years, after the school graduation. Number of female's students under this study are likely to be more than the males, who are enrolled for their Bachelor degree in the University of Technology and Applied Sciences, Higher College of Technology, for the three consecutive semesters, Muscat, Sultanate of Oman.

Statistical Techniques Used in the Present Study

In this paper, Single Factor ANOVA and a paired sample t- test comparing the means is carried out for the analysis. Mean, Variance, Person Correlation, Hypothesized Mean Difference and one-tail t-Test were sued to analyze the date.

Results

Initial test of normality had been carried out to the group to determine whether a parametric test warrants the

correct statistical approach to present the statistical significance. The figure on the next shows the boxplot of the marks in three mathematics courses, namely Basic Mathematics, Pure Mathematics and Calculus I. Clearly, we see that the distribution of the three groups approximately resembles a normal distribution. It can be noted however, that the Calculus group potentially had an outlier on the lower extremes. In addition, the Pure Mathematics dataset is slightly skewed base on the uneven distance of the median value to the first and third quartile. With this exploratory data analysis, the researchers decided to undertake a parametric testing of hypothesis and leaving other assumption to be true.

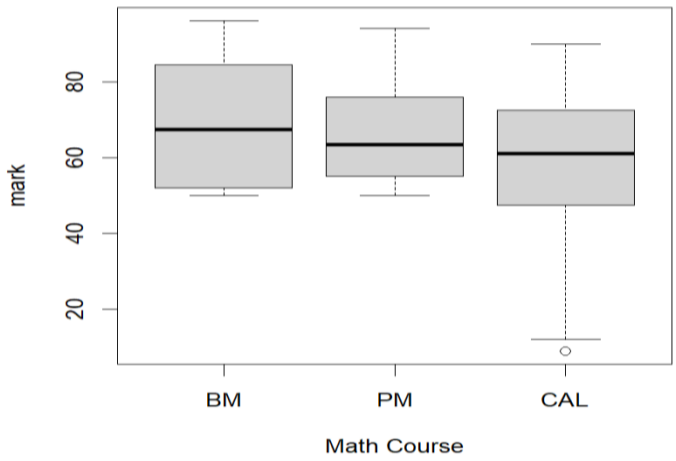

Figure 3. Graph of the Distribution of Marks in Basic Mathematics, Pure Mathematics and Calculus I

Compare the Basic Math, Pure Math, and Calculus Courses

Testing of hypothesis using the Single Factor ANOVA table is carried out for this analysis. The mean score performance of the three different mean student's performance in BASIC MATHEMATICS (BM)-F2F (Mode of Teaching) is equal to mean students' performance in PURE MATHEMATICS (PM) - BLD (Mode of Teaching), and also is equal to the mean students' performance in CALCULUS (CAL)-ONL (Mode of Teaching).

Table.1. Mean Mathematics Performance of the Students with Respect to the Different Learning Modalities for Math Core Specialization

Source of Variation	SS	df	MS	$F_{calculated}$	$F_{tabulated}$	Remarks*
Between Groups	3260	2	1630.4	6.47	3.00	S
Within Groups	50631	201	251.9			
Total	53891	203				

**p-value is approximately 0.002*

Table 1 above, illustrates that the decision is to reject the null hypothesis. It is noted that there is a statistically significant difference between the group means, which shows that the output of the significance value is below 0.05, ($F(2, 201) = 6.472$), $p < 0.001$). One mean is different from other was seen. To investigate further, it is required to proceed with multiple comparisons.

Table.2. Difference between the Basic Math (F2F) and Calculus I (Online) Academic Performances for Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Basic Math (BM)	68	68.8	16.2	-0.201	1.65	NS
	Calculus I (CAL)	68	59.3	18.5			

**Hypothesize mean difference is 10 marks; p-value is 0.421; one-tailed test*

A Paired sample t-Test compares the means of two score between BM and CAL courses, which is given in Table 2. The passing grades of both the courses having the mean difference of 10. There is no significance difference in the scores for BM and CAL, since the value is above 0.05. This proves that we are maintaining the same standards in the Assessments for BM and CAL courses.

Table.3. Difference between the Pure Math (Blended) and Calculus I (Online) Academic Performances for Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Pure Math (PM)	68	66.2	12.4	1.251	1.65	NS
	Calculus I (CAL)	68	59.3	18.5			

**Hypothesize mean difference is 10 marks; p-value is 0.108; one-tailed test*

A Paired sample t-Test compares the means of two score between PM and CAL courses, which is given in Table 3. The passing grades of both the courses having the mean difference of 10. There is no significance difference in the scores for BM and CAL, since the value is above 0.05.

Table.4. Difference between the Basic Math (F2F) and Pure Math (Blended) Academic Performances for Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Basic Math (BM)	68	68.8	16.2	1.717	1.65	S
	Pure Math (PM)	68	66.2	12.4			

**Hypothesize mean difference is 0 mark; p-value is 0.045; one-tailed test*

A Paired sample t-Test compares the means of two score between BM and PM courses, which is given in Table 4. Since, the passing grades of both the courses are same. There is a significance difference in the scores for BM and PM at boundary level, since the value is exactly closer to boundary of 0.05.

Compare the Basic Math, Applied Math and Managerial Statistics

Testing of hypothesis using the Single Factor ANOVA table is carried out for this analysis. The mean score performance of the three different mean students' performance in BASIC MATHEMATICS (BM)-F2F (Mode of

Teaching) is equal to mean students' performance in APPLIED MATHEMATICS (AM)- BLD (Mode of Teaching), and also equal to the mean students' performance in MANAGERIAL STATISTICS (MS)-ONL (Mode of Teaching).

Table.5. Mean Mathematics Performance of the Students with Respect to the Different Learning Modalities for Non-Math Core Specialization

Source of Variation	SS	df	MS	$F_{calculated}$	$F_{tabulated}$	Remarks*
Between Groups	5145	2	2572	25.4	3.00	S
Within Groups	14604	144	101			
Total	19749	146				

p-value is < 0.001

Table 5 below, illustrates that the decision is to reject the null hypothesis. It is noted that there is a statistically significant difference between the group means, which shows that the output of the significance value is below 0.05, ($F(2, 144) = 25.4$), $p < 0.001$). One mean is different from other was seen. To investigate further, it is required to proceed with multiple comparisons.

Since, there is a significance difference between the group means, we can investigate further by three Post Hoc test to find where the difference happens between BM and AM, or AM and MS or BM and MS.

Table.6. Difference between the Basic Math (F2F) and Applied Math (Blended) Academic Performances for Non-Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Basic Math (BM)	49	59.8	10.6	0.665	1.65	NS
	Applied Math (AM)	49	61.2	10.9			

Hypothesize mean difference is 0 mark; p-value is 0.255; one-tailed test

A Paired sample t-Test compares the means of two scores between BM and AM courses, given in Table 6. The passing grades of both the courses are same and having the zero-mean difference. There is no significance difference in the scores for BM and AM, since the value is above 0.05.

Table.7. Difference between the Basic Math (F2F) and Managerial Statistics (Online) Academic Performances for Non-Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Basic Math (PM)	49	59.8	10.6	15.745	1.65	S
	Managerial Statistics (MS)	49	73.0	8.5			

Hypothesize mean difference is 10 marks; p-value is < 0.001; one-tailed test

A Paired sample t-Test compares the means of two scores between BM and MS courses, is given in Table 7. The passing grades of both the courses having the mean difference of 10. There is significantly higher difference in the scores for BM and MS, since the value is Less 0.05.

Table.8. Difference between the Applied Math (Blended) and Managerial Statistics (Online) Academic Performances for Non-Math Core Specialization

Variable	Categories*	N	Mean	SD	$t_{calculated}$	$t_{tabulated}$	Remarks
Courses	Applied Math (BM)	49	61.2	10.9	10.850	1.65	S
	Managerial Statistics (MS)	49	73.0	8.5			

**Hypothesize mean difference is 10 marks; p-value is < 0.001; one-tailed test*

A Paired sample t-Test compares the means of two scores between AM and MS courses, given in Table 8. The passing grades of both the courses are same and having the zero-mean difference. There is significantly higher difference in the scores for AM and MS, since the value is less 0.05.

Discussion

This paper ambition to uncover the relationship between the mathematics performance in three different modes of teaching using a dedicated cohort of students. It was found out that there is difference in the mathematics performance, if the learning modalities used were face to face, blended, and online learning. Face to face being superior in the later. This result has been supported by a number of recent studies in literature. One of them concluded that Face to Face modality is the only modality of teaching that preserves the teaching - student relationship in an informal teaching and learning environment. Moreover, the results of this paper fully support this teaching ideology and anchored to the most common School of Thoughts in Education.

This paper however is limited in terms of context, since only the marks of the students are readily available for research consumption. It would be a good exercise to look into the segmentation of the students by gender and by a prior variable like their performance in elementary school as a mediating or compounding variable.

Conclusion

As a result of the Comparative Study on Student's Mathematical Performance in Face to Face, Blended Learning and Online Teaching and Learning Education during the Covid-19 Pandemic. The students' scoring performance in Basic Math to Calculus in the three modes of teaching and learning between the F2F, Blended and Online are not significantly affected. The result reveals that due to the student's high scoring performance in Basic Math to Managerial Statistics in the three modes of teaching and learning between the F2F, Blended and Online are significantly affected. Further analysis, will be investigated in detail to find the affecting factors such as Time Management, Assessment, Home Environment, Collaboration, Homework, Teaching Quality, Skill development,

Problem solving ability, Motivation, Help received and Student satisfaction, which made them to score high marks in above said courses.

Recommendations

Based on the findings of the study, the following recommendations were developed;

- Face to face is still preferred than online/blended course as it reflect is the true perspective of the student
- Establish a good assessment methodology while maintaining the integrity regardless of the mode of teaching
- Non-core math track needs more attending in different type of mode of education.

Acknowledgements or Notes

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Examining High School Students' Academic Amotivation

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Abstract

This research aimed to examine the academic amotivation of high school students. To that end, the academic amotivation levels of high school students were determined, and their amotivation levels were compared according to some demographic variables. The study group of the research consisted of 318 students studying at different high schools in Bursa, Turkey, in the fall semester of the 2021-2022 academic year. "Demographic Information Form" and "Academic Amotivation Scale" were used to collect data. Data were analyzed by applying descriptive statistics, independent groups t-test, and a one-way analysis of variance. The results showed that high school students had moderate academic amotivation. Students' academic amotivation levels differed significantly according to gender, grade level, school type, income level, and parental education. Based on the research results, some suggestions for practice have been developed.

Keywords: Academic amotivation, Demographic variables, High school students.

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Introduction

Today, academic amotivation has become an important problem for the education community. Teachers find it difficult to include students with low academic motivation. Lack of motivation can cause reluctance and, therefore, discipline problems. Investigating the factors associated with academic amotivation can better understand the factors that cause amotivation. In this study, the level of academic amotivation of high school students was examined by comparing them according to some demographic characteristics. The results obtained can be a guide to increase the quality of guidance services to provide and maintain motivation.

Motivation comprises internal and external factors that reveal, control and maintain behavior (Sutherland, 1995, p. 282). The individual is taking action for a behavior depends on his motivation. Motivation significantly affects the behavior's severity, energy level, and continuity (Akbaba, 2006, p.347). In this respect, motivation can be defined as an internal force that activates the individual and pushes him to perform some behaviors. The motivation process has a complex structure. However, it is possible to explain the motivation process with four stages. These stages are; need arousal, action, and satisfaction. Requirements form the source of motivation. The individual takes action to meet his needs. When the individual meets his needs, he finds comfort. There are physiological and psychological needs. Needs such as hunger and thirst are physiological needs. Needs such as love, security, and belonging are psychological needs. The driving force that moves the individual to meet the needs is arousal. In order to meet the needs, the individual needs to take action. It is possible to take action with arousal. The action begins with movement. The primary purpose of the action is to meet the needs of the individual. The final stage of motivation is satisfaction as long as the needs are met, the satisfaction of the individual experience. After satisfaction, new needs may occur in the individual. The stages in the motivation process can continue as a cycle (Kodaz, 2016, p.27).

Academic motivation is related to enthusiasm and energy in the academic field (Direktör & Nuri, 2017, p.67). Students with high academic motivation show more effort and perseverance to succeed in their courses. Academic motivation has a significant impact on student success. Because, thanks to motivation, students make more effort to insist on and work on academic issues. Thanks to academic motivation, students gain the necessary energy for academic work. Academic motivation creates the will and power to fulfill the duties and responsibilities of the academic field. It is associated with cognitive, affective, and behavioral factors related to the academic field, such as academic motivation, creative thinking, school satisfaction, school engagement, and homework performance (Vallerand et al., 1992). Intrinsic motivation, extrinsic motivation, and amotivation are essential components of academic motivation. Intrinsic motivation is divided into three intrinsic motivations knowing, achieving, and experience. Getting satisfaction from participating in an activity in the academic field, discovering, achieving, and learning are indicators of intrinsic motivation. The source of motivation may also depend on external factors. The individual can also take action to obtain rewards, money, praise, and grades. Individuals with high extrinsic motivation may see the task they need to accomplish as a tool that will lead them to a reward. Another dimension of motivation is amotivation. Characteristics such as lack of intention to develop behavior, not taking action, not being motivated internally or externally, and reluctance is indicators of amotivation. Unmotivated individuals cannot establish a relationship between activity and behavior. Unmotivated individuals do not have enough

intention and impulse to perform a particular behavior (Ergin & Karataş, 2018, p.872). Weakening self-efficacy belief for a task or not valuing a task can cause a lack of motivation (Deci & Ryan, 2000, p.237).

Many pieces of research related to academic motivation have been carried out in Turkey. It was determined that the Academic Amotivation Scale developed by İlter (2019) by Legault, Green-Demers, and Pelletier (2006) was adapted into Turkish. The four-factor scale consisting of sixteen items showed an acceptable level of agreement with the data obtained from Turkish high school students. Academic achievement/performance and personal factors are among the subjects most commonly associated with motivation in Turkey (Yurt, 2022). Sıcak and Başören (2015) stated that lack of academic motivation differs according to gender, grade level, academic average, settlement, and school satisfaction. Yurt and Bozer (2015) reported that male students had a higher lack of motivation. However, Türk and Gürkan (2019) stated that lack of motivation did not differ according to gender and grade level. İlter (2021) stated that academic amotivation explains 29% of the change in academic achievement.

Loss of motivation related to the value attributed to the task, ability beliefs, and effort beliefs negatively affect academic achievement. Zembat et al. (2018) stated that there is a negative and significant relationship between academic amotivation and academic grade point average. Lack of motivation is common in schools. Lack of motivation is a significant problem for both teachers and students. Students who lack motivation may experience feelings of helplessness and dissatisfaction. It may not be possible for teachers to continue their teaching services in a healthy way in the classroom where students with low academic motivation are present. In this respect, it is crucial to investigate the factors that cause students' lack of academic motivation. Knowing the factors related to academic amotivation can provide better quality guidance services. This study aimed to examine the academic amotivation of Turkish high school students according to different variables. For this purpose, answers to the following research questions were sought.

1- What is the level of academic amotivation of high school students?
2- Does the academic amotivation of high school students differ significantly by gender?
3- Does the academic amotivation of high school students show a significant difference according to the grade level?
4- Does the academic amotivation of high school students differ significantly according to the type of high school?
5- Does the academic amotivation of high school students differ significantly according to their monthly income?
6- Does the academic amotivation of high school students differ significantly according to their mother's education level?
7- Does the academic amotivation of high school students differ significantly according to their father's education level?

Method

Model of the Research

This study was carried out based on the causal comparison design. Causal comparison studies are studies that aim

to "determine the causes and consequences of differences between human groups without any intervention on conditions and participants" (Büyüköztürk et al., 2008, p.16). This study used the causal-comparative research design; the academic amotivation levels of high school students were compared according to gender, class, school type, income, and mother and father education level.

Research Sample

The participants of this study consist of 318 students studying at different high schools in Bursa, Turkey, in the fall semester of the 2021-2022 academic year. The students were included in the study by choosing the convenient sampling method. However, in selecting the sample, it was tried to provide diversity in secondary education institutions within the Turkish education system. Anatolian, vocational, science and social sciences high school students were reached in this direction. All of the students participated in the study voluntarily. Demographic information of the students included in the study is given in Table 1.

Table 1. Distribution of Students by Demographic Characteristics

		f	%
Gender	Female	164	51.6
	Male	154	48.4
Age	14	65	20.4
	15	93	29.2
	16	86	27.0
	17 and over	74	23.3
Class	9	73	23.0
	10	93	29.2
	11	89	28.0
	12	63	19.8
School type	Anatolian High School	110	34.6
	Vocational High School	65	20.4
	Science High School	61	19.2
	Social Sciences High School	82	25.8
Income	Low	38	11.9
	Medium	245	77.0
	High	35	11.0
Mother's education level	Primary school	61	19.2
	Secondary School	65	20.4
	High School	73	23.0
	Associate Degree	54	17.0
	Undergraduate and above	65	20.4
Father's education level	Primary school	42	13.2
	Secondary School	56	17.6
	High School	64	20.1
	Associate Degree	56	17.6
	Undergraduate and above	100	31.4

When the table is examined, it is understood that 51.6% of the students are female and 48.4% are male. 23% of the students are in the ninth, 29.2% in the tenth, 28% in the eleventh, and 19.8% in the twelfth grade. 34.6% of the students are in Anatolian High School, 20.4% in Vocational High School, 19.2% in Science High School, and 25.8% in Social Sciences High School. A large proportion of the students (77%) stated that their income level is medium. Most mothers are in high school (23%), and a large proportion of fathers are graduates of undergraduate or higher (31.4%).

Research Instruments

Demographic Information Form: A demographic information form developed by the researcher was used to determine the diagnostic characteristics of the students. Questions about gender, age, class level, income status, school type, and mother and father education were included. The questions are of multiple-choice type.

Academic Amotivation Scale (AAS): The Academic Amotivation Scale developed by Legault, Green-Demers, and Pelletier (2006) and adapted into Turkish by İlter (2019) was used to determine the level of academic amotivation of students. The scale, which consists of 16 items, is in 7-point Likert type. The measurement tool has dimensions of value placed on the task, Ability beliefs, Characteristics of the task, and Effort beliefs. All items on the scale are negative. High scores obtained from the scale indicate a high level of academic motivation. The Cronbach alpha coefficient calculated for the scale in this study was 0.87.

Data Analysis

The academic amotivation scale scores distribution was analyzed based on the skewness and kurtosis coefficients. For the normal distribution assumption to be met, it is sufficient for the skewness and kurtosis coefficients to be in the range of ±1 (Tabachnick & Fidell, 2007). It was observed that the skewness and kurtosis coefficients calculated in this study were within the specified range (Table 1).

Table 2. Descriptive Values of Scores from the Academic Amotivation Scale

Variables	M	SD	Skewness		Kurtosis	
			z	SE	z	SE
Value placed on the task	10.60	5.67	0.66	0.14	-0.39	0.27
Ability beliefs	10.18	5.54	0.78	0.14	-0.13	0.27
Characteristics of the task	15.52	7.18	0.11	0.14	-1.00	0.27
Effort beliefs	13.98	6.48	0.22	0.14	-0.82	0.27
Total (AAS)*	50.29	20.36	0.22	0.14	-0.64	0.27

*All items on the scale are negative. High scores obtained from the scale indicate a high level of academic amotivation

Independent groups t-test was used to compare students' academic amotivation scores by gender. One-way analysis of variance was used to compare the scores according to the variables of grade level, school type, income, and educational status of parents. Data were analyzed using SPSS 24.0 statistical package program.

Results

Table 1. Examination of Academic Motivation of High School Students by Gender

Variables	Gender	N	M	SD	t(316)	p
Value placed on the task	Female	164	9.68	5.42	-3.03	0.00*
	Male	154	11.58	5.78		
Ability beliefs	Female	164	10.06	5.47	-0.40	0.69
	Male	154	10.31	5.64		
Characteristics of the task	Female	164	15.05	7.18	-1.21	0.23
	Male	154	16.02	7.17		
Effort beliefs	Female	164	14.54	6.48	1.59	0.11
	Male	154	13.39	6.46		
Total (AAS)	Female	164	49.34	20.40	-0.86	0.39
	Male	154	51.31	20.33		

*p<0,05

When Table 1 is examined, it is understood that there is no significant difference between Ability beliefs, Characteristics of the task, Effort beliefs and Total score averages by gender (p>0.05). However, the mean Value placed on the task score showed a significant difference according to gender (p<0.05). Men are more likely to be amotivated with value placed on the task.

Table 2. Investigation of Academic Motivation of High School Students by Grade Level

Variables	Class	N	M	SD	F(3;314)	p	Scheffe Post-Hoc
Value placed on the task	9	73	10.04	5.96	1.99	0.12	-
	10	93	10.16	5.79			
	11	63	10.16	5.13			
	12	89	11.84	5.57			
Ability beliefs	9	73	10.37	5.69	1.57	0.20	-
	10	93	10.28	5.55			
	11	63	8.90	4.98			
	12	89	10.83	5.75			
Characteristics of the task	9[a]	73	13.00	6.45	6.87	0.00*	d>a,
	10[b]	93	15.03	7.21			
	11[c]	63	15.75	7.16			
	12[d]	89	17.93	7.06			
Effort beliefs	9	73	12.84	6.20	2.27	0.08	-
	10	93	13.49	6.64			
	11	63	14.13	6.85			
	12	89	15.34	6.14			
Total (AAS)	9[a]	73	46.25	20.66	3.56	0.01*	d>a,
	10[b]	93	48.97	20.38			
	11[c]	63	48.94	18.88			
	12[d]	89	55.94	20.23			

*p<0,05

When the Table 2 is examined, it is understood that there is no significant difference between the value placed on the task, Ability beliefs, and Effort beliefs scores according to class level (p>0.05). However, the Characteristics of the task and Total score averages showed a significant difference according to the grade level (p<0.05). It was observed that twelfth-grade students' general academic amotivation related to the Characteristics of the task was higher than that of ninth-grade students.

Table 3. Investigation of Academic Motivation of High School Students by School Type

Variables	School Type	N	M	SD	F(3;314)	p	Scheffe Post-Hoc
Value placed on the task	Anatolian High School [a]	110	9.19	5.87	8.23	0.00*	b>a, b>d,
	Vocational High School [b]	65	13.26	5.14			
	Science High School [c]	61	11.25	5.51			
	Social Sciences High School [d]	82	9.91	5.19			
Ability beliefs	Anatolian High School [a]	110	9.45	5.17	5.11	0.00*	b>a, b>c,
	Vocational High School [b]	65	12.43	5.99			
	Science High School [c]	61	9.15	5.39			
	Social Sciences High School [d]	82	10.16	5.37			
Characteristics of the task	Anatolian High School [a]	110	16.86	7.93	0.52	0.66	-
	Vocational High School [b]	65	15.00	7.22			
	Science High School [c]	61	15.78	6.91			
	Social Sciences High School [d]	82	15.53	7.57			
Effort beliefs	Anatolian High School [a]	110	14.55	6.31	0.63	0.60	-
	Vocational High School [b]	65	13.57	6.50			
	Science High School [c]	61	13.91	6.12			
	Social Sciences High School [d]	82	15.04	7.53			
Total (AAS)	Anatolian High School [a]	110	45.24	20.46	3.71	0.01*	b>a,
	Vocational High School [b]	65	54.42	20.18			
	Science High School [c]	61	52.16	20.93			
	Social Sciences High School [d]	82	52.40	18.90			

*p<0,05

When the Table 3 is examined, it is understood that the average scores of Characteristics of the task and Effort beliefs do not differ significantly according to the type of school (p>0.05). However, the value placed on the task, Ability beliefs, and Total score differed significantly by school type (p<0.05). In general, vocational high school students have higher academic motivation. Anatolian high school students, on the other hand, have lower academic motivation.

Table 4. Examination of Academic Motivation of High School Students by Income Level

Variables	Income level	N	M	SD	F(2;315)	p	Scheffe Post-Hoc
Value placed on the task	Low	38	11.95	4.83	1.21	0.30	-
	Medium	245	10.42	5.79			
	High	35	10.43	5.59			
Ability beliefs	Low [a]	38	13.11	6.39	7.90	0.00*	a>c,
	Medium [b]	245	10.01	5.35			
	High [c]	35	8.23	4.81			
Characteristics of the task	Low	38	16.92	7.27	1.60	0.20	-
	Medium	245	15.53	7.21			
	High	35	13.91	6.71			
Effort beliefs	Low	38	15.24	6.30	0.86	0.43	-
	Medium	245	13.86	6.57			
	High	35	13.49	6.04			
Total (AAS)	Low [a]	38	57.21	20.09	3.06	0.048*	a>c,
	Medium [b]	245	49.82	20.61			
	High [c]	35	46.06	17.44			

*p<0,05

When the Table 4 is examined, it is understood that the average scores of Characteristics of the task and Effort beliefs do not differ significantly according to the type of school (p>0.05). However, the value placed on the task, Ability beliefs, and Total score differed significantly by school type (p<0.05). In general, vocational high school students have higher academic motivation. Anatolian high school students, on the other hand, have lower academic motivation.

Table 5. Investigation of Academic Motivation of High School Students by Mother Education Level

Variables	Mother's education level	N	M	SD	F(4;313)	p	Scheffe Post-Hoc
Value placed on the task	Primary school	61	11.98	6.24	1.43	0.22	-
	Secondary school	65	10.31	5.67			
	High school	73	9.71	5.49			
	Associate degree	54	10.78	5.66			
	Undergraduate and above	65	10.46	5.23			
Ability beliefs	Primary school [a]	61	12.93	5.86	5.58	0.00*	a>c, a>d, a>e,
	Secondary school [b]	65	10.26	5.62			
	High school [c]	73	9.48	4.87			
	Associate degree [d]	54	9.52	5.31			
	Undergraduate and above [e]	65	8.77	5.23			
Characteristics of the task	Primary school	61	16.08	7.16	1.17	0.32	-
	Secondary school	65	15.75	7.60			
	High school	73	15.58	6.90			
	Associate degree	54	13.67	6.95			
	Undergraduate and above	65	16.23	7.23			
Effort beliefs	Primary school	61	15.69	6.53	2.10	0.08	-
	Secondary school	65	14.23	6.47			
	High school	73	13.86	6.65			
	Associate degree	54	12.26	5.78			
	Undergraduate and above	65	13.71	6.59			
Total (AAS)	Primary school	61	56.69	21.98	2.17	0.07	-
	Secondary school	65	49.77	18.85			
	High school	73	49.41	20.46			
	Associate degree	54	46.22	19.62			
	Undergraduate and above	65	49.17	20.00			

*p<0,05

When the Table 5 is examined, it is understood that there is no significant difference between the value placed on the task, the characteristics of the task, Effort beliefs, and Total score averages according to the mother's education level (p>0.05). However, the mean Ability beliefs scores differed significantly according to the mother's educational status (p<0.05). Students whose mothers are primary school graduates have higher academic motivation related to Ability beliefs. Academic amotivation related to Ability beliefs is lower than that of students whose mothers have an associate's degree and undergraduate and above.

Table 6. Examination of Academic Motivation of High School Students by Father Education Level

Variables	Father's education level	N	M	SD	F(4;313)	p	Scheffe Post-Hoc
Value placed on the task	Primary school [a]	42	12.74	6.40	4.54	0.00	a>c, a>d,
	Secondary school [b]	56	11.68	6.10			
	High school [c]	64	9.23	5.30			
	Associate degree [d]	56	8.86	5.08			
	Undergraduate and above [e]	100	10.96	5.24			
Ability beliefs	Primary school [a]	42	13.79	6.32	7.95	0.00	a>c, a>d, a>e,
	Secondary school [b]	56	11.30	5.35			
	High school [c]	64	9.97	5.34			
	Associate degree [d]	56	8.39	4.77			
	Undergraduate and above [e]	100	9.18	5.11			
Characteristics of the task	Primary school	42	17.36	7.44	2.03	0.09	-
	Secondary school	56	14.23	7.10			
	High school	64	15.75	7.23			
	Associate degree	56	13.98	7.53			
	Undergraduate and above	100	16.18	6.73			
Effort beliefs	Primary school [a]	42	17.38	6.98	5.20	0.00	a>c, a>d,
	Secondary school [b]	56	14.13	6.55			
	High school [c]	64	13.73	6.01			
	Associate degree [d]	56	11.52	6.02			
	Undergraduate and above [e]	100	14.02	6.25			
Total (AAS)	Primary school [a]	42	61.26	23.06	5,39	0,00	a>c, a>d,
	Secondary school [b]	56	51.34	21.76			
	High school [c]	64	48.69	18.51			
	Associate degree [d]	56	42.75	19.61			
	Undergraduate and above [e]	100	50.34	18.08			

When the Table 6 is examined, it is understood that there is no significant difference between the father's education level and the Characteristics of the task mean score (p>0.05). However, the value placed on the task, Ability beliefs, Effort beliefs, and Total score averages showed a significant difference according to the father's education level (p<0.05). Students whose fathers are primary school graduates were found to be more academically unmotivated.

Discussion

This study, it was aimed to examine the academic amotivation of high school students. In this direction, the academic amotivation scores of the students were compared according to the variables of gender, class, school type, income level, and educational status of the parents. According to the results obtained, high school students' lack of academic motivation is moderate. Students' lack of motivation differed according to some demographic characteristics.

The results showed that the high school students included in the study had a moderate academic amotivation. This indicated that the students had a lack of motivation. Lack of academic motivation is an important problem for both students and teachers. The individual is taking action for a behavior depends on his motivation. Motivation significantly affects the severity, energy level, and continuity of the behavior (Akbaba, 2006; Vallerand et al., 1992). In this respect, lack of motivation can negatively affect students' study performance, interest in the lesson, class participation, homework performance, school satisfaction, and school commitment. High school students' acquiring near and distant goals in the academic field can increase their academic motivation.

Another result of the study is that male students have higher amotivation related to the value placed on the task. This result is consistent with the results of some studies in the literature (Arslan, 2021; Sıcak & Başören, 2015; Tuncer, Yelken & Tanrıseven, 2018; Yerlikaya, 2014; Yurt & Bozer, 2015). Some studies have stated that lack of motivation does not show a significant difference according to gender (Türk & Gürkan, 2019). Studies in the literature and the results of these studies have shown that gender is an essential factor affecting motivation.

According to the results, twelfth-grade students have the highest academic motivation. On the other hand, ninth-grade students have the lowest academic motivation. It was observed that as the grade level increased, the lack of academic motivation increased. There are studies in the literature stating that grade level is effective on academic motivation (Ali, 2016; Çakır, 2006; Ergin & Karataş, 2018; Sıcak & Başören, 2015; İlğan et al., 2013). However, it is possible to come across studies reporting no lack of academic motivation according to grade level (Arslan, 2021). The senior students' focusing on exams, staying away from extracurricular activities, being undecided about choosing a profession, and experiencing exam-related anxiety and stress may have negatively affected their academic motivation.

According to the results, vocational high school students have higher academic amotivation. Anatolian high school students, on the other hand, have lower academic amotivation. Studies in the literature state that the type of school is effective on academic motivation (Aktaş, 2016; Seyis, 2011). A large proportion of Anatolian high schools in our country accept students by central examination or according to the school average. Vocational high schools have lower acceptance scores than other schools. Students with academic career goals and higher success prefer schools with higher scores, such as Anatolian high schools. Therefore, it is expected that the academic motivation of the students who attend these schools is higher than those who attend the vocational high school.

This study found that the academic motivation of high school students differed according to their income level.

High school students with low-income levels have higher academic amotivation than students with high-income levels. The results obtained are consistent with the results of the studies in the literature (Aktaş, 2016; Seyis, 2011; Yazıcı, 2009). Higher-income students are more likely to access opportunities such as courses, workshops, and private lessons. These students can more easily access resources that will help their lessons. They may face fewer financial barriers to achieving their academic goals. These students can be expected to have lower academic motivation.

Students whose mothers are primary school graduates have higher academic motivation related to Ability beliefs. Academic motivation related to Ability beliefs is lower than that of students whose mothers have an associate's degree, a bachelor's degree, or higher. Students whose fathers are primary school graduates were found to be more academically unmotivated. According to these results, it was observed that the student's academic motivation deficiencies increased as the parents' education level decreased. The results obtained are consistent with the results of some studies in the literature (Demir & Arı, 2013; Türk & Gürkan, 2019). A study stated that maternal education level is negatively related to academic motivation.

Conclusion

As a result, high school students' academic amotivation is moderate. Male students have higher amotivation related to the value placed on the task. It was observed that as the grade level increased, the lack of academic motivation increased. Vocational high school students have higher academic motivation. Anatolian high school students, on the other hand, have lower academic motivation. According to the income level, the academic motivation of high school students differs. It was determined that as the parents' education level decreased, the student's academic motivation deficiencies increased.

Recommendations

Academic amotivation negatively affects students' interests, attitudes, and desire for lessons. In this respect, knowing the factors associated with academic amotivation can provide better quality guidance services. It should be considered that there may be a gender-related difference in academic amotivation. Grade level, school type, income level, and parental education are variables associated with academic amotivation. Senior high school students, vocational high school students, students with low-income levels, and students whose parents are primary school graduates may need more support in maintaining their academic motivation. This situation can be taken into account while continuing the guidance services. Studies on different samples can increase the generalizability of the results obtained.

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Development And Evaluation of a Software Program Specifically Designed for Music Courses Within the Framework of Primary Education Curriculum

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Abstract

This study aims to analyze the effect of computer-aided instruction on the 4th-grade primary school students' achievement, attitude, and retention in music courses. It employs a pretest-posttest control group design. For ethical purposes, informed consent forms were obtained from the primary school affiliated with the Ministry of National Education Directorate in Afyon. Turkey. The study participants are 11 female, nine male students in the control group, ten male, and ten female students in the experimental group. A computer-aided teaching software was developed for the experimental group to contribute to the 4th-grade music course implementations within the scope of the curriculum. A total of 9-hour instruction was carried out for both groups. Data were collected through achievement tests and a primary school music course attitude scale. Mann Whitney U Test and Wilcoxon Signed Rankings Test were used to comparing the groups' achievement test and attitude scale scores. The findings revealed that computer-aided teaching in the experimental group was more effective in students' success and attitude toward music courses. Also, computer-aided teaching practices were found to be more effective in student retention.

Keywords: Music education, Computer-assisted learning, Education software, Academic success, Music lesson attitude, Experimental research design.

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Introduction

The place of music and music education is considered very important in the cognitive, affective, and psychomotor development of the individual. In this respect, music has been one of the most important parts of educational activities from ancient times to the present and has been used as an essential tool in shaping human behavior. Today, music teaching activities in different education levels, such as primary school, secondary school, high school, and university, are delivered to young generations with compulsory and elective courses (Tarman, 2006; Yağışan & Sünbül, 2009).

The inadequacy of traditional teaching has led to educational scientists' research and implementation of new approaches. Because the "information society" demands alternative approaches to traditional teaching (Koyuncuoglu, 2021; Yalın, 2002; Yılmaz & Sünbül, 2002). In the century we live in, the accuracy value of information changes in a short time. In order to keep up with this change, it is necessary to train creative thinkers instead of individuals with template thinking skills. In addition, there are individual differences in education. The way each student acquires musical knowledge and skills may differ. In this regard, it is recommended to use different methods and techniques in music teaching at primary and secondary school levels (Sünbül, 2004).

Computer-assisted teaching in education; It has been stated that students have a positive effect on their learning speed and creative thinking skills. Thanks to technological applications in music education, different kinds of information can be blended, and different cultures can interact with each other in the digital world. Visual and audio materials can be used as a whole with such applications. This way, it is possible to reach musical goals easily for a short time. Making music lessons easily applicable with computer-aided teaching applications and integrating and interacting with existing teaching processes will make significant contributions to this field (Baş, Kubiatko, and Sünbül, 2016; Sarıkaya, 2022).

The inadequacy of traditional teaching has led to educational scientists' research and implementation of new approaches. Because the "information society" demands alternative approaches to traditional teaching (Kara, 2021; Sünbül, 2000). In the century we live in, the accuracy value of information changes in a short time. In order to keep up with this change, it is necessary to train creative thinkers instead of individuals with template thinking skills. In addition, there are individual differences in education. The way each student acquires musical knowledge and skills may differ. In this respect, it is recommended to use different methods and techniques in music teaching at primary and secondary school levels. Teachers should discover the best learning methods for students and choose and use appropriate teaching techniques for effective learning (Doğru, 2020; Kilincer, 2022).

Thanks to the developing technologies and digital equipment in education, it has become straightforward to write notes, vocalize, compose, arrange, develop music software, share musical information, develop musical information, and share all kinds of comments and information about music. Developing and widespread use of keyboard and synthesizer instruments brought a new perspective to music education and musical performance. In addition, the discovery of MIDI (Musical Instrument Digital Interface), which enables musical instruments to communicate and work in harmony with each other, has significantly contributed to individual and group studies

in the field of music. In music education, new methods have been discovered with the development of software that serves the purpose of teaching activities. Today, new developments are recorded in music education every day due to technological developments (Koç, 2004).

Three main effects have occurred in the design of instructional technologies (Knirk & Gustafson, 1986). The first of these; is related to the fact that the teaching aid materials used while teacher-centered should focus on the materials that students will use predominantly. Distance education and lifelong education approaches make it more valuable and beneficial to design instructional technologies students will use to learn. Technological developments and developments in the knowledge we acquire about learning are the other two main effects on the design of instructional technologies (Alan and Sünbül, 2010; Kaleli, 2021).

Computer-assisted instruction can be defined as the whole of activities in which the learners interact with the lessons and activities designed in the computer environment during the learning-teaching process, where the teacher plays the role of a guide, and the computer plays the role of a rich environment and platform (Sünbül, Gündüz & Yılmaz, 2002). All the above elements are necessary for computer-assisted teaching applications to reach their goals. However, when we look at the factors affecting computer-assisted teaching practices and processes, we can see that innovations, student motivation, individual learning differences, interaction, quality and scope of course software, teacher's readiness for computer-assisted education, perception, attitude, changing role, attitudes and course content. It is seen that it includes various variables such as its integration with the education program and the way the computer-aided education application is transformed into practice within the school framework (Sünbül, 2010; Şahin and Yıldırım 1999; Sendogdu & Koyuncuoglu, 2022).

In computer-assisted teaching, the computer does not take the teacher's place. The computer allows the teacher to create interactive learning environments in the classroom environment. It is possible to benefit from computer applications by using different methods in the teaching process. The primary purpose of computer-assisted teaching is to help increase the quality of learning (Assylzhanova et al., 2022; Bayrak, 2005; Kaleli, 2021). Computer-assisted instruction uses educational computer software as a teaching tool. This teaching process helps to create individual learning-teaching processes. This way, students can plan their learning processes at their own pace. Studies have revealed that computer-assisted instruction has many benefits that affect students, teachers, and the teaching process. Computer-assisted instruction creates a safe environment for learning to take place. It helps students meet their individual needs. It delivers rich information resources to students (Rıza, 1997).

Computer-assisted teaching is a broad approach that includes different methods and techniques. Depending on this situation, the researchers aimed to examine the computer-aided methods in more detail by gathering them under different headings. Computer-assisted teaching methods include computer-aided tests, interactive multimedia and hypermedia environments, and intelligent teaching systems. The most commonly used software type in computer-assisted teaching is special tutorial programs. In special tutorial programs; repetition, trial, practice, and measurement-evaluation activities are given importance (Demirci, 2003; İşman, 2003; Yılmaz and Sünbül, 2003).

Unique instructional program designs are prepared by teaching principles and methods. The teaching process is planned step by step, based on behavioral, cognitive, and constructivist teaching approaches together. Special training programs; It can be said that there are educational programs that teach the subject like a teacher, provide practice opportunities, motivate students toward the lesson, and provide feedback by evaluating student success (Gürol, 2004; Kaya, 2005; Uşun, 2000; Yalın, 2001).

The use of music technology in music education is an ongoing process: On the one hand, it is entirely dependent on the achievements of the science/technology community; On the other hand, it is a process that requires a progressive mentality change in a society where many processes and techniques remain very traditional. The development of new music teaching systems faces many challenges. Music educators must now ensure that their administrators understand that music should be part of their plans to use computers in school. The arts have been a powerful driver in the development of new technologies, and when our students apply their musical skills and inquiry to computer applications, they develop all-around skills as they develop computer skills. Using BBL in the Arts, especially in music education, unleashes the imagination and encourages students to master the skills that learning as a computer processor is much more powerful. In addition, the multimedia environment provides awareness of music and sound abilities and the development of visual literacy. There seems to be a considerable gap between what technology and digitization can provide today and the extent to which technology is used in music education. Digitization in music education is discussed extensively among research institutions, teaching institutions, music academies, and music education associations. However, there is little progress in how digitization is widely applied in real teaching situations today (Crawford, 2009; Savage, 2009).

The inadequacy of traditional music teaching has led to the research and implementation of new approaches by music educators. In addition, there are individual differences in music education. The way each student acquires musical knowledge and skills may differ. In this respect, it is recommended to use computer-assisted teaching methods and techniques in music teaching at primary and secondary school levels. In this research context, is there a significant difference between the achievement, attitude, and permanence of the students in the groups in which computer-assisted teaching (experiment) and current teaching programs are applied in primary school fourth-grade music lessons? Within the framework of this purpose of the research, answers were sought to the following questions:

1. Is there a significant difference between the achievement pre-test results of the experimental and control groups?
2. Is there a significant difference between the attitude pre-test results of the experimental and control groups?
3. Is there a significant difference between the achievement post-test results of the experimental and control groups?
4. Is there a significant difference between the attitude post-test results of the experimental and control groups?
5. Is there a significant difference between the permanence test results of the experimental and control groups?
6. Is there a significant difference between the experimental group's achievement post-test and pre-test results?
7. Is there a significant difference between the achievement post-test and pre-test results of the control group?

Method

Research Model

of computer-assisted teaching applications applied in primary school fourth-grade music lessons on students' achievement, attitudes, and permanence of what were learned were investigated. The research was carried out in the pretest-posttest model with a control group, one of the actual experimental models. According to Karasar (2002), it is vital to fulfilling three rules inaccurate trial models. In this context, there are at least two groups, experimental and control, in the design created for the actual trial model, the pre-test is applied at the beginning of the applications, and the post-test is applied at the end. In addition, the assignment of subjects to the experimental and control groups is done by random method. In this study, computer-assisted music education in the experimental group and the current fourth-grade music education program were applied in the control group. Since the effect of experimental practices in music lessons on students' achievement, attitude, and permanence of what has been learned was investigated, achievement and music lesson attitude scales were applied to the research groups as a pre-test in the study. As the other rule of the real trial model, the same scales and tests were applied to the subjects as post-test and retention tests at the end of the application.

Research Sample

Experimental and control groups were formed per the principles of the control group pretest-posttest model in this study, in which the effects of computer-assisted teaching applications applied in primary school fourth-grade music lessons on students' achievement, attitudes, and attitudes, and permanence of what was learned was investigated. For this purpose, necessary permissions were obtained to implement the research in a primary school affiliated with the Afyon Provincial Directorate of National Education. One branch (n=40) with an even number of students from the three classes in the school was determined for random assignment to the experimental and control groups. There are twenty-one female and ninety male students in the class. Eleven female and nine male students were randomly assigned to group 1, and ten female and ten male students to group 2 by random assignment. Then, these two groups were assigned as the experimental and control groups by random method. In the final stage, eleven girls and nine boys were in the control group, and ten boys and ten girls were in the experimental group. The parents of the children studying in the classroom within the scope of the research have similar socioeconomic and educational statuses. Classroom teachers conduct music lessons in all classes at the school. The proximity to the postgraduate institution of the research, the motivation of school administrators and teachers to conduct the research, the school's necessary support in experimental practices, and the positive attitude and interest in art in the school were influential in determining this school as a research center.

Experimental Process

The following experimental procedures were carried out in this study, in which the effect of computer-aided teaching applications applied in primary school fourth-grade music lessons on students' achievement, attitude, and permanence of what was learned was investigated.

1. Computer-aided instruction software was developed to be applied in the experimental group. For this purpose, a music lesson educational software program has been developed that contributes to implementing the fourth-grade music lesson acquisitions following the primary school curriculum. In this context, a plan was prepared that exemplifies the content related to 2 learning outcomes from the 'Let's Create Rhythm and Tune' learning area, three outcomes from the 'Different Rhythmic Structures' learning area, and finally one outcome from the 'Let's Dance' learning area, and transforms it into an activity. Then, a courseware draft was prepared that represents and exemplifies the relevant learning areas and achievements appropriate to the readiness level of the children, attracting their attention and motivating them to the activities. At this stage, the opinions of 1 primary school music teacher, one academician with a doctorate in music education, one instructional technologist, one computer programmer, and one expert in the education programs and teaching field were consulted.

The software was developed by having these prepared plans and drafts coded by a software company. After the field experts examined the developed software, the software was finalized with the feedback and correction suggestions made to the software company. This software consists of two stages. The first stage is screening animated films aimed at making students comprehend the acquisitions in the related learning area. The second stage is to test the content gained by the animation demonstration for the relevant learning area through the game. Animation demonstration aims to gain students' subjects related to the relevant learning field, measure how much they gain these subjects, and increase their motivation. In addition, the software company created the Android version of the game stage. In this way, students reinforced what they learned by playing games outside the classroom. In the development of computer-assisted teaching software, the principles and instructions of the fourth-grade music lesson curriculum and the activities' explanations were taken into account.

2. Testing the reliability and validity of the tests and scales to be applied in the research. In this context, the primary school music lesson attitude scale and fourth-grade music lesson achievement test were developed, and their reliability and validity were tested before the research.

3. Formation of experimental and control groups. At this stage, a group of students studying at the fourth-grade level of primary school was assigned as the trial and control group according to the criteria of the accurate trial model.

4. Music lesson achievement test and attitude scale were applied to both groups as a pre-test. The application was carried out simultaneously on the same day.

5. Computer-Aided Music Education in the Experimental Group and the current fourth-grade music education program in the control group were applied simultaneously. The implementation took place in 9 hours within the framework of the instruction of the curriculum. At this stage, a teacher's guidebook prepared according to the principles of the current fourth-grade music lesson curriculum was applied to the control group.

6. Music lesson achievement test and attitude scale were applied to both groups as post-test after experimental procedures. The application was carried out simultaneously on the same day.

7. After the experimental applications, no procedure was performed in both groups for 15 days.

8. Finally, the music lesson achievement test and the attitude scale were applied to both groups as a post-test 15 days after the experimental procedures. The application was carried out simultaneously on the same day.

Research Instruments

In this study, in which the effect of computer-aided teaching applications applied in primary school fourth-grade music lessons on students' achievement, attitude, and permanence of what has been learned, primary school music lesson attitude scale and fourth-grade music lesson achievement test were used to collect the necessary data.

Achievement Test

In the research, an achievement test was developed to be used in the fourth-grade music lesson's pre-test, post-test, and retention measurements. For this purpose, first of all, the learning area and achievements of the fourth-grade music lesson, which is the basis for preparing the computer-assisted curriculum for the experimental applications of the research, were examined. At this stage, the music lesson curriculum and united annual plans prepared by the Ministry of National Education were taken as the basis. In this context, a table of specifications was prepared that exemplifies the content related to 2 acquisitions from the 'Let's Create Rhythm and Tune' learning area, three acquisitions from the 'Different Rhythmic Structures' learning area, and finally, one acquisition from the 'Let's Dance' learning area. Then, multiple-choice questions representing and examining the relevant learning areas and acquisitions were prepared.

The opinions of a primary school music teacher, one academician with a doctorate in music education, and one assessment and evaluation expert were consulted. Based on expert opinions, a total of 20 questions were prepared consistent with the achievements of the fourth-grade music lesson. This way, the content validity of the whole test and each item was ensured. Then, these questions were formed with four options, taking into account the age and class characteristics of the target group to which the research will be applied. According to Özçelik (2013), creating an order with four options is essential, taking into account the readiness of children for multiple-choice tests in the primary school curriculum. The developed 20-question multiple-choice fourth-grade music lesson achievement test was applied to a group of 144 students in May 2018. In selecting this group, the criteria of studying in the 4th grade and achieving these gains in the lessons were considered.

Item and test analyze were made on the data of the fourth-grade music lesson achievement test, which was tested. As item analysis, pj-item difficulty index, rjx-item discrimination index, and sj-item statistics of each item in the test were calculated. According to the analysis, it was seen that 20 items of the fourth-grade music lesson had difficulty between 0.45 and 0.86. According to Özçelik (2013), it is stated that tests consisting of items with medium difficulty will give more reliable results in achievement test applications for research purposes. It was observed that the music achievement test developed for the study consisted of items of medium difficulty. In the

second stage of the test development, each item's item discrimination index was calculated. This index is distinctive and essential in distinguishing between those who have and those who do not. According to Turgut (1992), item discrimination should ideally have a coefficient above 0.30 in achievement tests. According to the analysis, it was seen that the discrimination indices of all the items of the primary school fourth-grade music lesson developed for the study were above 0.30. Thus, an achievement test consisting of items with medium difficulty and high distinctiveness features was obtained. The final stage in the development of the fourth-grade achievement test was the procedures performed to ensure the reliability of the test as a whole. According to Turgut (1992), KR-20 Internal Consistency Coefficient is the most appropriate method for reliability in tests scored 1-0, especially in exams that measure success. This technique was preferred because it gives an effective reliability coefficient by considering each item and the test's total score in an application. According to the item and test analysis, the KR-20 reliability of the primary school fourth-grade music lesson achievement test was calculated as 0.82. This finding shows that the test developed to measure the related achievements of the students in the fourth-grade music lesson has a high internal consistency and reliability. After these calculations, the final version of the Primary School Fourth Grade Music Lesson Achievement Test was created.

Primary School Music Lesson Attitude Scale

The scale developed by Özmentaş (2006) was used to measure the attitudes of primary school fourth and secondary school fifth grade students towards the music lesson. There are 20 items, 8 of which are negative and 12 of which are positive, on the scale of attitude towards primary school music lessons. In the scale where the Likert-type rating system is applied, a respondent gets points between 20 and 100. High scores obtained from the scale indicate positive attitudes and tendencies towards music lessons, while low scores indicate negative attitudes and tendencies towards music lessons. New approaches applied in music lessons must develop positive attitudes towards this field in students. This is also among the general objectives of primary school art classes (Mullins, 1984: 17).

The trial application of the primary school music lesson attitude scale was carried out on 144 students. The exploratory factor analysis technique was used to test the construct validity of the Primary School Music Lesson Attitude Scale. The scale results are KMO=0.983 and Barlet Test=1893.514 ($p<0.01$) according to the procedures performed with Varimax Exploratory Factor Analysis. These values show that the scale is suitable for factor analysis in representing the relevant structure, and the study group is suitable for the scale. Due to its Eigenvalue (Eigenvalue), the 1-dimensional scale has a high explanatory level with a variance value of 52.44%. The Scree Plot graph showed that the elementary school fourth-grade music lesson attitude scale has a one-dimensional structure. It was observed that each item of the scale had a factor load of over 0.45 with its unidimensional structure. These findings show that the primary school fourth-grade music lesson attitude scale has high validity.

The Cronbach Alpha method was used to test the reliability of the primary school music lesson attitude scale, and the analysis result was calculated as 0.95. In addition, it is seen that the correlation coefficients between the items of the scale and the total scores are above 0.588. These data show that all items and the whole scale measure attitudes towards music lessons in a distinctive way. These findings reveal that the primary school music course

preferred to be used in the research has high validity, reliability, and consistency.

Data Analysis

In this study, in which the effect of computer-aided teaching applications applied in primary school fourth-grade music lessons on students' achievement, attitude, and permanence of what has been learned, was tested, the Shapiro Wilk test was applied to test the suitability of the research data to the normal distribution. Non-Parametric Statistical Techniques were used in the study because some data did not meet the normal distribution assumptions. The research data were arranged in Excel 10.0 program, and all statistical operations were carried out in SPSS 22.0 program.

Results

Table 1. Comparison of Pre-Experimental Achievement Test Scores of Experimental and Control Groups

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	p
Pre achievement test	Experimental	20	20.83	416.50			
	Control	20	20.18	403.50	193.50	-0.177	0.862
	Total	40					

When the Table 1 is examined, there is no statistically significant difference between the achievement test pre-test scores of the experimental group, in which the BDI practices are applied in the music lesson, and the control group, in which the current applications in the music education program are performed ($p>0.05$). According to this result, it can be said that the music lesson success levels of the fourth-grade students in the experimental and control groups before the experimental procedure are equivalent to each other.

Table 2. Comparison of Experimental and Control Groups' Pre-Experimental Attitude Scale Scores

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	p
Pre attitude test	Experimental	20	18.10	362.00			
	Control	20	22.90	458.00	152.00	-1.312	0.201
	Total	40					

When Table 2 is examined, there is no statistically significant difference between the attitude scale pre-test scores of the experimental group in which the BDI practices are applied in the music lesson and the control group in which the current practices in the music education program are performed ($p>0.05$). It can be said that the positive attitudes of the fourth-grade students in the experimental and control groups towards the music lesson were at a similar level before the experimental procedure.

Table 3. Comparison of the Experimental and Control Group's Post-Experimental Achievement Test Scores

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	p
Post achievement test	Experimental	20	27.73	554.50			
	Control	20	13.28	265.50	55.50	-3.935	0.000
	Total	40					

When Table 3 is examined, there is a statistically significant difference between the achievement test post-test scores of the experimental group, in which the BDI applications are carried out in the music lesson, and the control group, in which the current applications in the music education program are performed ($p<0.05$). After the experimental procedure, it was observed that the fourth-grade students in the experimental group increased their music lesson achievement scores more. This result indicated that the BBL practices in the experimental group were more effective in increasing the success of fourth-grade students in music lessons compared to the current curriculum in the control group.

Table 4. Comparison of the Experimental and Control Groups' Post-Experimental Attitude Scale Scores

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	p
Post attitude test	Experimental	20	26.65	533.00			
	Control	20	14.35	287.00	77.00	-3.345	0.001
	Total	40					

When Table 4 is examined, there is a statistically significant difference between the attitude pre-test scores of the experimental group, in which the BDI practices are applied in the music lesson, and the control group, in which the current applications in the music education program are performed ($p<0.05$). After the experimental procedure, the experimental group students increased their attitude test scores more. This result showed that the BBL practices applied in the experimental group contributed more to the fourth-grade students' positive attitudes towards the music lesson compared to the music teaching program applied in the control group.

Table 5. Comparison of the Retention Test Scores of the Experimental and Control Groups

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	p
Retention Test	Experimental	20	26.55	531.00			
	Control	20	14,45	289,00	79.00	-3.292	0.001
	Total	40					

When Table 5 is examined, there is a statistically significant difference between the permanence test scores of the experimental group, in which the BDI practices were performed in the music lesson, and the control group, in which the current practices in the music education program were performed ($p<0.05$). This result showed that CBL practices were more effective in ensuring the permanence of what was learned than the fourth-grade music

curriculum.

Table 6. Comparison of the Experimental Group's Achievement Test Scores Before and After the Experimental Procedure

Group	Variable	Post-test- Pre-test	N	Mean Rank	Sum of Ranks	Z	p
Experimental	Achievement Test	Negative rank	20	10.50	210.00	-3.925	0.000
		Positive rank	0	0.00	0.00		
		Ties	0				
		Total	20				

When Table 6 is examined, there is a statistically significant difference between the mean achievement test scores obtained from the experimental group of students in the music lesson before and after the experimental procedure ($p<0.05$). The achievement test scores obtained from the experimental group students after the experimental procedure were significantly higher than those obtained after the experimental procedure. This result indicated that the CBL activities applied in the music lesson effectively increased the fourth-grade students' success.

Table 7. Comparison of the Control Group's Achievement Test Scores Before and After the Experimental Procedure

Group	Variable	Post-test- Pre-test	N	Mean Rank	Sum of Ranks	Z	p
Control	Achievement Test	Negative rank	14	10.29	144.00	-1.982	0.047
		Positive rank	5	9.20	46.00		
		Ties	1				
		Total	20				

When Table 7 is examined, there is a statistically significant difference between the achievement test pretest-posttest scores of the control group students to whom the music education program was applied ($p<0.05$). The achievement test scores obtained from the experimental group students after the experimental procedure were significantly higher than those obtained after the experimental procedure. This result indicated that the current music education program effectively increased the success of fourth-grade students.

Discussion

In this study, the effects of computer-assisted teaching applied in primary school fourth-grade music lessons and the effects of the current music teaching program on the achievement, attitude, and permanence of the learned students in the groups were compared; significant results were obtained. As a result of the applications and analyses carried out with the first sub-problem of the research, it was seen that the students in the experimental group who applied computer-assisted music teaching achieved significantly higher post-test success than their

friends in the group in which the current program was applied. These findings are similar to the results of many studies in the literature (Aşkar and Olkun; Çelen, Çelik and Seferoğlu, 2011; Lim & Ching, 2004; Wang, Zhang, Wang & Zhang, 2017; Mills & Murray, 2000). A study conducted by Jonassen and Reeves (1996) on this subject revealed that the conscious use of computer-assisted education technology in lessons has an effective potential in realizing the achievements of the subject area and improving the quality of the lesson (Çağıltay et al., 2001).

The combination of computers and music education to provide a good learning environment to achieve predetermined teaching goals with the computer-assisted music education approach has been influential in the emergence of this result. When computers are used systematically in teaching musical composition or arrangement, musical notes, and musical instruments, students' achievements and achievements increase (Wu, 2007; Gao, 2007; Cheng, 2007). Many related studies have shown positive opinions about the results of computer-assisted music teaching (Chan, Jones, Scanlon, & Joiner, 2006; Yang, Lay, Liou, Tsao, & Lin, 2007; Lee, 2007). After the experimental procedure carried out, the experimental group students increased their achievement test scores more. This result showed that the BBL practices in the experimental group were more effective in increasing the students' success in music lessons compared to the current curriculum in the control group. In the emergence of this result, with the help of computer-aided music software, auditory and visual senses are brought together as a whole by listening, singing, and providing the opportunity to interact with stimuli over and over in the integrity of learning. In addition, various sensory organs of the students are activated through computer-assisted music teaching, and the learning effect is much better, more effective, and more affluent than using a single organ (Wang, Zhang, Wang, & Zhang, 2017). For this reason, the effectiveness and quality of music learning are significantly improved with the help of computer music software (Liu, 2016). The findings of many music lesson studies supported the findings in the first sub-problem of this research. Green (2003) examined the effects of computer-assisted education on students' guitar performance and general musical success. In addition, the effects of computer-assisted instruction on different abilities and skill groups were examined with a standardized test. The study examined the long-term effects of interactive computer-aided Guitar software. According to the research findings, although computer software is not effective in short-term applications, significant increases were observed in guitar skills and music lesson success in general when applied in a long-term and programmatic manner. In the study, it was also seen that computer-assisted music lesson applications were most successful in talented students with above-average skills.

Another study that revealed similar results to the study's findings was carried out by Glenn (2000). Glenn's (2000) mixed model study examined the effects of the Smart Music smart accompaniment program on applied oboe, clarinet, and bassoon skills at the university level. As a result of the experimental applications, when the smart companion program was used, it was observed that the students in the experimental groups performed higher than their peers in the control group. In addition, students who received oboe, clarinet, and bassoon training accompanied by computer-aided software stated that they benefited from smart accompaniment software for these qualitative questions and that these practices contributed to their musicianship.

Another finding reached in the study is that there is a statistically significant difference between the attitude post-test scores of the experimental group in which BDI was applied in the music lesson and the attitude post-test

scores of the control group in which the current MEB music education program was applied. After the experimental procedure, the experimental group students increased their aptitude test scores significantly. This result showed that the BBL practices applied in the experimental group were more effective in developing positive attitudes towards the music lesson of the students compared to the current MEB music lesson curriculum in the control group. These findings are supported by many studies in the literature (Benson, 2002; Aşkar & Olkun, 2005; Boshuizen & Wopereis, 2003; Çelen, Çelik & Seferoğlu, 2011; Lim & Ching, 2004).

It is seen that the use of information and communication technologies in educational environments increases student success and motivation, as well as contributes to the development of high-level thinking skills and positive attitudes towards the lesson (Aşkar and Olkun, 2005; Boshuizen and Wopereis, 2003; Çelen, Çelik, and Seferoğlu, 2011; Lim and Ching, 2004). Technological development, which can also be considered a product of the educational process, also changes the structure of all educational processes and brings a different perspective to practices and approaches (Tor & Erden, 2004). Different approaches, practices, exposure to active stimuli, rich content, content suitable for children's readiness, and the use of remarkable tactics and techniques with a practical music lesson software have positively affected the students' attitudes. In a similar study, Benson (2002) examined the effects of a computer-assisted instructional environment that can provide audio, video, and multimedia models on student performances and attitudes in student group piano activities. As a result of his study, the researcher found that students' attitudes towards the lesson, their interest increased, and their general affective characteristics such as self-confidence and self-concept were positively affected. According to Godwin-Jones (2013), integrating computer technology with lessons provides experiential learning, better understanding, strong interaction between students and teachers, motivation for learning, and self-study environments. Students' learning abilities and motivation can be improved by using computers and related technologies, and technology provides interactive and exciting techniques in academic courses, and computer technology positively affects students' attitudes by presenting complex content efficiently (Bahrani & Sim, 2012). In general, the use of computer technology in education has made the classroom and music lessons more attractive and exciting, and students' active participation in the lesson has increased their motivation and attitudes.

One of the findings reached in this study is the comparison of the permanence test scores of the experimental group in BDI in the music lesson with the permanence test scores of the control group to which the current curriculum was applied. The analysis of the study showed that the CBL music practices applied in the experimental group were more effective in ensuring knowledge permanence than the current music lesson curriculum in the control group. The findings reached in the current study are similar to the research findings of Barg (2009). According to Barg (2009), easiness, economy, and learners come to the forefront in dealing with priority issues in music lessons with computer-assisted teaching music education applications. These factors make the music learning process more prosperous and interactive, improving students' musical skills, performances, and performances. Similarly, a multivariate study by Jaschke, Eggermont and Honing (2013) examined the relationships between computer-assisted teaching practices in music education and academic achievement and cognitive skills.

Conclusion

According to the research findings, technologically supported enriched teaching environments and practices in music lessons positively affect academic achievement, high-level mental skills such as analysis, synthesis, multiple performances, and mental permanence.

Recommendations

According to the results of the research, the following recommendations can be made:

- With the applications carried out in this thesis, it has been observed that computer-assisted teaching applications are effective in realizing the achievements of music lessons in primary schools. In this context, examples of computer-aided teaching applications should be placed in music education programs. It forms the core of this study, which aims to realize the interaction with the instructional software and the achievements of the music lesson. In this context, the potential of the instructional software designed for the study, the use of the teacher, and the interaction between the software and students can be tested with different studies. In this context, it is suggested that research and development of music lesson teaching software should focus on the effects of the interaction between the software and students.
- This research, in which the effects of computer-assisted teaching in music lessons in primary school fourth grades are tested with experimental methods, can be supported by qualitative research methods.
- Even if there is a well-produced software in the music lesson, it may not be sufficient for teaching alone. Therefore, creating a warm atmosphere in the classroom and good interaction between teacher and students will be the key to successful computer-assisted teaching.
- Regarding the standards of computer-aided music lessons, teachers need to have basic knowledge, skills, and attitudes that can both use technology, integrate it into their fields, and organize the school and classroom environment in a way that learners can use. In this context, it is recommended to include computer-aided music teaching courses in teaching programs that train music teachers.

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